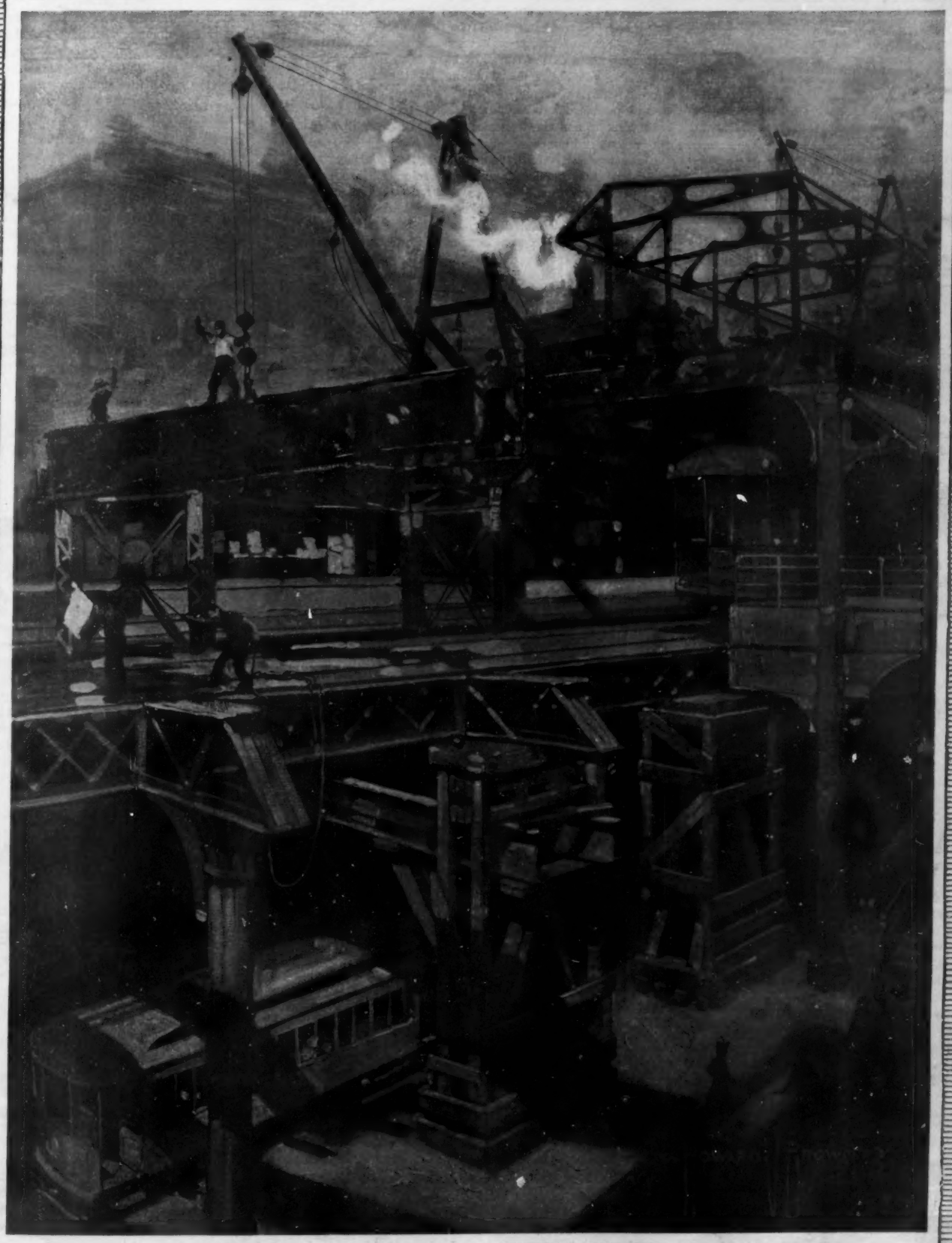
SCIENTIFIC AMERICAN



RAILROAD BUILDING UNDER AND OVER THE STREETS OF NEW YORK.—[See page 142.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contribution will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

As It Was in the Beginning

IT is a commonplace to say that the war has been full of surprises. Among these none has been more striking than the reversion to early and long-abandoned forms and practices of warfare.

We all remember the prediction, based upon the operations of the Boer War, that because of the range and accuracy of the rifle fire, frontal attacks in massed formation would no longer be made; that the advance would be made in widely extended order and that the decisive tactics would consist almost entirely of flanking or turning movements. It was predicted furthermore that the tactical necessity of fighting at long range would lead to the abandonment of the bayonet and that rarely, if ever, would the combatants commingle in hand to hand fighting.

All of which apparently well-founded predictions have been falsified by the event. For nigh upon twelve months some four millions of men have been facing each other upon a battle-line several hundred miles in length and in such close contact that a rush of less than one hundred yards has been sufficient to precipitate the bloodiest hand to hand struggle with bayonet and hand-grenade.

And the mention of the hand-grenade brings us down to our text; for this is but one of several medieval and ancient forms of fighting which the exigencies of the present war have revived and established firmly as part of the tactics of modern warfare.

The fundamental cause of all this is to be found in the extraordinary development of trench or what might be called field-siege warfare. The hand-grenade formed in early days an important weapon of attack in the assault on permanent fortifications, and so efficient was this weapon that special bodies of men were trained in its use and carried the name of grenadiers.

Where the weight of the bombs or the distance to be covered demands it, recourse has been had to the catapult, a device which is as old as the recorded history of warfare itself.

In the poison gases, so-called, of the Germans we recognize at least in principle the "stinkpot" of the Chinese and the "Greek fire" of the ancients.

Only recently in our columns we illustrated a steel helmet that has been introduced among the French troops which is strongly reminiscent of the medieval casque; and a further revival of medieval warfare is to be found in the use of steel breastplates and of movable shields pushed forward in advance of the attacking troops.

That the use of armor in siege warfare, such as that which has been carried on in France, is likely to be extended, is suggested in a dispatch from London to the Associated Press, which says that the value of a light protective armor is attested in several recent articles in the British medical journals. According to the New York *Times* Doctor Devraigne, a French army surgeon, who discusses in the *Lancet* the result of his tests of the new French helmet, gives it his unqualified endorsement. He says that the soldier who wears a helmet escapes light wounds of the head, and even wounds that would in ordinary circumstances have been severe, have been greatly mitigated. The helmet frequently turns off the bullet, and in other cases dents or stops it, and even when the helmet is perforated, it checks the velocity of the bullet so that hair and dirt are not driven into the tissues of the head.

Lastly, the return to primitive methods of fighting is seen in a late report from the Italian campaign that thousands of the enemy have been killed and wounded by stones and rocks hurled upon them by the Italian mountain troops.

The Decline of Our Merchant Marine

THE object lesson of the results of the lack of an American merchant marine in the overseas trade, so vividly brought home to the people of the United States during the existing conflict between the great European nations, involving as opponents the two greatest international maritime carriers, Great Britain and Germany, and the fact that so many British ships have been withdrawn from the world's carrying trade to meet the needs of government service and the merchant fleets of the Germans have been driven from the seas, has set this whole nation thinking as to how to devise means for the restoration of our American merchant marine. It is true our pride was hurt when the American fleet of warships on its recent trip around the world was obliged to be accompanied throughout its entire journey by a host of the merchant ships of foreign nations converted into auxiliaries, colliers, and supply vessels, but this did not have the disastrous effect of crippling our agricultural, industrial and commercial interests. The dislocation of our internal economic affairs incident to the present war has demonstrated the necessity for this country to develop its overseas transportation facilities to as high a point of efficiency as it has already developed its agricultural and industrial organization. It is absurd to expect that the United States will continue indefinitely in the status of a nation carrying less than 10 per cent of its exports and imports in ships flying its own flag, thereby rendering itself liable to calamitous commercial effects when international disturbances arise in which we are not participants and over which we have no control.

The recollection of our past performance should be sufficient to stimulate us to free ourselves from such a condition of commercial servitude. In 1861 the United States and Great Britain ran neck and neck for supremacy as the great international carriers of the world, the tonnage of the former being 5,482,127 and of the latter 5,895,369. We have been prone to attribute to the civil war our decline as an international carrier. It is curious, however, that since 1870, five years after the conclusion of hostilities between the States, Germany, which previously had almost no merchant marine, gradually took the place of the United States as the rival of Great Britain in this respect, and this has admittedly been accomplished by the efficient work of her legislative and administrative machinery combined with the enterprise of her shipowners. The inference is inevitable that we have been lacking in either or both of these factors.

Our shipowners have persistently asserted that the natural and artificial handicaps against them have been so great that it was hopeless for them to expect to recapture the share of this trade to which the United States is entitled, overseas carriage being a bargain in which no one nation can assume successfully to dictate all the terms. As evidence of their ability successfully to perform their part of the undertaking, where not unduly handicapped, they point with pride to their magnificent fleets of large steamers trading all over our enormous extent of seaboard on both the Atlantic and the Pacific oceans and on the Great Lakes, aggregating nearly seven million gross tons, on routes many of which extend to several thousands of miles, and which alone rank this country as easily the second maritime nation of the world. They have also as persistently asserted that had the United States Congress assiduously addressed itself to the undertaking, a solution of the problem would have been evolved long ago; and, moreover, that not the least of the handicaps which have strangled their efforts have been those imposed upon them by Governmental action or by the lack of such Governmental support as has been given by both Germany and Great Britain to their merchant marine.

The Needs of the National Academy of Sciences

A RECENT pamphlet entitled, "The National Academy of Sciences," which sketches the history and activities of the foremost American scientific body, says in regard to the needs of this organization: "The greatest need of the Academy is for a building located in Washington, which would serve as its headquarters and permanent home."

Such a building is unquestionably needed, and its erection is merely a question of time. Tentative plans for it have already been drawn. As the Academy is essentially a Government institution, a home should be provided for it by Congress. We believe, however, that the Academy itself needs above all a far greater measure of public attention than it has heretofore received, or, indeed, sought.

To this day it is unfortunately true that to the average educated American the National Academy of Sciences is no more than an empty name. Certainly the Academy is incomparably less familiar to the American public than the Royal Society is to Englishmen or the *Académie des Sciences* to Frenchmen; yet it is more nearly analogous to these renowned institutions of the Old World than any other scientific organization in this country.

A striking illustration of the facts just stated will be found in the history of Secretary Daniels's scheme for an advisory board on inventions in connection with the Navy. The National Academy was organized in 1863 under an act of Congress which provided that "the Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art." During its existence of more than half a century it has, through committees appointed for the purpose, furnished reports to the Government on a large number of scientific and technical subjects, ranging from the testing of sugars and the preservation of paint on army knapsacks to the adoption of a rational forest policy and the scientific exploration of the Philippines. Yet, apparently, in constituting his board on inventions, Mr. Daniels entirely ignored the National Academy of Sciences, which is not even included in the list of scientific societies from whom suggestions as to the membership of the board were invited! What is decidedly more striking and significant is the fact that the newspapers throughout the country have not generally called attention to this astonishing omission.

Within the last few months the Academy appears to have been receiving attention in the press. This is desirable for at least two reasons. In the first place, the Academy can hardly hope to get the home it needs at the national capital or funds, either from Congress or from private donors, with which to enlarge its useful activities, so long as it continues to be a vague abstraction in the mind of the average citizen. It must, to use a stereotyped phrase, be known to be appreciated. In the second place, while membership in the National Academy is supposed to be the highest honor that can come to the American man of science, such a distinction cannot have its full value until the name of the Academy becomes as much a household word in America as that of the Royal Society is in Great Britain.

The True Science of War

IF war is in any sense a science, military men, who have studied the subject, should be able to form judgments markedly better than those of the man in the street. The fact is that this present war is so different from all other wars, that the extent and kind of the difference has not yet been wholly realized by the people most constantly and intimately concerned.

The difference is not merely one of bigger armies and bigger guns, superior methods of transport and communication. The real difference lies in the change in the relative importance of the various factors which are concerned in the prosecution of a war. The emphasis has been altogether shifted.

In previous centuries, given equal generalship and fighting spirit, the bigger army won; it was a fluke if it did not. But now, when the military expert is told the number of men on each side, the positions they hold, the kind of generals they have, and the *morale* of the troops, he is still without the most important factor for a sound calculation. He requires further to know what the people are doing who are not on the battlefield. How many munition factories, and of what quality, are there behind each army; and how many thoroughly trained, keen, flexible-minded young men are there engaged in thinking out great methods of destruction?

The importance of this latter element, the importance of possessing a perfectly organized army of competent men to do nothing but think, is only beginning to be recognized by any of the countries at war. Germany has probably realized it most, and her successes are obviously due to the superior organization for thought she has established rather than to any superior bravery or generalship in the field. Neither England nor France has shown much discrimination in this matter. In England practically anyone can enlist who is physically fit. A brilliant young scientific man is taken as readily as a brilliantly talkative salesman. They are both dressed in khaki and put in a trench. Bad sight is a disqualification, but the possession of the F. R. S. is not. Surely there is something a little shortsighted about this policy.

If America is ever organized for war, and if we ever have a really efficient Inventions Board and Development Laboratory, the military experts of the enemy will find forecasting exceedingly difficult, for they will never be able to calculate the difference that incessant, organized activity in scientific laboratories at home will make to the armies in the field.

Electricity

Montevideo Central Station.—The city of Montevideo now possesses an electric plant of large size, and within a recent period it has been extending operations on a good scale. In the station are now erected four alternators operated by horizontal steam engines. One of these alternators is of 1,000 kw. size, while the other three have 1,700 kw. capacity each. In addition to these groups, a steam turbine set of European make was erected in 1911, this group being rated at 4,000 kw. and it runs at 1,500 revolutions per minute, but it can be run on 5,000 kw. load for a short time. This steam turbine set has now given such good results that a second group of the same kind was ordered at a later date. The state of Uruguay has made great progress in modern applications of electric current, and it is said that the government is engaged on plans for erecting electric stations in different small towns which are established on a well-designed and uniform plan.

Wheat or Rye Flour is commonly used to thicken the electrolyte used in dry batteries for pocket lamps. Owing to shortage of flour in Germany during the war, substitutes must now be used. According to the London *Engineer*, the following binding materials are recommended: Glass-wool, sawdust, gelatine, starch, kieselguhr and water-glass. The following instructions are given for compounding the electrolyte: 140 grammes of well-powdered salammoniac, 40 grammes of zinc chloride, 10 grammes of ammonium sulphate are mixed together in a porcelain bowl with 10 grammes of thick refined glycerine. The mixture is then covered in small quantities with distilled water at a temperature of 40 deg. Cent. and energetically stirred until the materials are dissolved into a concentrated solution. This mixture is allowed to soak into the binding material, and the paste so formed is filled into the cells, which are closed with a paraffined card top sealed with bottle-wax. In the cover two small glass tubes are provided for the escape of such gases as are generated within the cell. In compounding the electrolyte, calcium acetate can be mixed with advantage with equal parts of the salammoniac. Such a solution possesses excellent conductivity, is hygroscopic and does not crystallize or creep.

Electricity in Small Industries.—The Paris correspondent of the SCIENTIFIC AMERICAN writes of the advantages afforded by electric current to the small industries in Europe. Artisans now become operators of small but well-arranged mechanical plants, and use all the most recent labor-saving devices which are run by electric motors. Small industries now share the advantages of the large ones in obtaining a better and more regular production, thus increasing the value of the products, and the amount of business is augmented for the same general expenses. Cost of hand labor is also reduced. For instance, the carpenter formerly required two days work to make a simple door, but now he is able to make ten in the same time by improved machine tools run on motors. Three helpers which he required are now reduced to one for the same work. He pays $50 yearly for current, but economizes $500 in salaries. In order to turn out 100 pounds of dough with the electric kneader, the baker pays about $0.02 for current, where formerly the men's wages for the same work amounted to $0.23. Where one helper makes up about 130 pounds of flour per hour, the mechanical process handles ten times as much in the same time; also giving a better product which sells more readily. Hygienic conditions are met in a most approved way. Many other examples taken from various industries might be cited to the same effect.

Fire-damp Protected Devices.—It is fairly a problem to install motors, controllers and other apparatus in mines in such a way as to avoid the danger of igniting fire damp. Modern practice in Europe now provides three different protecting methods: all-inclosed, partially inclosed with use of wire gauze plates, and oil-bath apparatus. Various apparatus, such as transformers, controllers and switches, need to have a special design for use in mines, not only on account of fire damp, but because of prevailing dampness and dirt. But in such cases an oil bath can be employed such as could not be used for motors. Some recent types of apparatus show a very careful design for this class of work. One of these is an all-inclosed controller for use upon 3-phase motors up to 5,000 volts, especially for running winches, hoists, pumps and cable traction for spoil cars. Contacts of the controller run in oil so that there is no danger from arcs. Good means are provided for taking off the oil-box portion, as this is limited to the row of contacts and is made in a separate piece. Heretofore, it appeared impossible to make up a practical switching box for use on high tension which is impervious to the action of fire damp, but we mention a recent device which is claimed to solve the problem. It is used upon heavy currents and high voltage, and can be employed together with a transformer at the bottom of the mine. In another case the oil-bath transformer box forms the base of the apparatus, with the ironclad switch box mounted at the top so as to make up a single device; the switch is worked by a hand wheel.

Science

The British Association.—In spite of the present untoward conditions in the Old World, the long series of yearly meetings of the British Association for the Advancement of Science will not be interrupted. The Association is to meet at Manchester in September, but will dispense with most of the social functions that normally add so much to the attractiveness of these gatherings.

Seasonal Variations in Human Activity.—Prof. Ellsworth Huntington of Yale University recently inaugurated an interesting series of daily tests, mental and physical, upon a number of boys and girls at Hampton Institute, for the purpose of determining how human activity varies with the seasons, as well as with different degrees of humidity and other atmospheric conditions. These tests are to continue for at least a year.

Weather Forecasts on Motion-picture Screens were first shown at Birmingham, Ala., in January, 1912, since which time their display in this manner has been extended to 15 cities and at 27 moving-picture theaters. The Weather Bureau is willing to furnish forecasts for this purpose wherever they are desired, but the demand for them is limited by the fact that most moving-picture shows do not open until an evening hour subsequent to the time at which the same forecasts appear in the afternoon newspapers.

New Fruits from China.—The Bureau of Plant Industry reports that its agricultural explorer, Mr. F. N. Meyer, who already had so many remarkable "finds" to his credit, has recently sent in an unusually interesting collection of new fruits from the Tibetan border of China. These include the Tangutian almond, the Potanin peach, and a notable series of wild forms of the ordinary cultivated peach. Mr. Meyer's latest expedition succeeded in reaching Lanchowfu, when further progress was prevented by the desertion of the interpreter. Recent collections have largely augmented the Agricultural Department's stock of jujubes and persimmons from western China.

The International Institute of Agriculture is one of the most remarkable examples extant of co-operative effort among the nations in humanitarian and scientific work. Since the present war began its activities have proceeded almost as in times of peace, though it is to be feared that the entrance of Italy into the conflict will prove a formidable handicap, as the Institute has its headquarters in Rome. As if to emphasize its superiority to the present political situation the Institute has published a pamphlet, dated Rome, 1915, giving an interesting history and description of this great international enterprise, and making no allusion to the war. The pamphlet is fully illustrated with views of the Institute's beautiful home, built for it by the King of Italy, and with portraits of its principal officers.

The Determination of Longitude by Wireless Telegraphy was a striking feature of the recently concluded exploration and delimitation of the Bolivia-Brazil boundary, carried out by a joint commission of the two countries, as described by Commander Edwards, of the Brazilian party, in the *Geographical Journal*. There is a powerful wireless station at Port Velho, about 1,500 miles from the Atlantic Ocean at the head of navigation on the Madeira River. The first step was to determine the position of this place accurately. A party was left here with instructions to send wireless time signals every night at a specified time. The rest of the expedition then began its explorations to the westward, carrying a portable wireless outfit which was set up each night in time to receive the signal, the antenna being stretched as high as possible between two or three trees. The longitudes of all camping places were thus obtained with great accuracy, and were used to check the intermediate traverses.

Anæsthesia in Ancient Times.—Anyone who supposes that the surgical use of anæsthetics, either general or local, is peculiar to modern times should read an article recently published by Dr. J. de Fenton, in the *South African Journal of Science*. Various anæsthetizing media and methods were, in fact, well known both in antiquity and during the Middle Ages. Homer mentions the anæsthetic effects of nepenthe; Herodotus states that the Scythians obtained similar effects from the vapors of hemp, produced by throwing hemp seed on hot stones. A Chinese physician of the third century B. C. gave his patients a preparation of hemp to make them insensible during surgical operations. The most important anæsthetic of ancient and medieval times was, however, wine of mandragora, the use of which is mentioned by a great number of early writers, and is referred to by Shakespeare. More recently, in the year 1760, the German surgeon Weiss, better known as Albinus, amputated the foot of Augustus III, King of Poland, while under the influence of mandragora. Two other anæsthetizing agencies were employed in very early, times, viz., arterial compression and hypnotism. It is said that the ancient Assyrians produced a lethargic state by compression of the carotid artery before performing the operation of circumcision.

Astronomy

Lady Huggins, who died last March, had, notwithstanding serious illness, devoted the latter years of her life to the task of compiling an orderly account of her late husband's work in astronomical spectroscopy—in most of which she had been his able collaborator. It is understood that this task was left unfinished at her death.

The Astronomical Society of India.—An account of this society, the first of its kind to be established in India, was presented by Mr. H. G. Tomkins at a recent meeting of the British Astronomical Association. The society was founded about 1910 in consequence of the interest aroused by Halley's comet, and now has about 150 members, including both Europeans and natives. Monthly meetings are held.

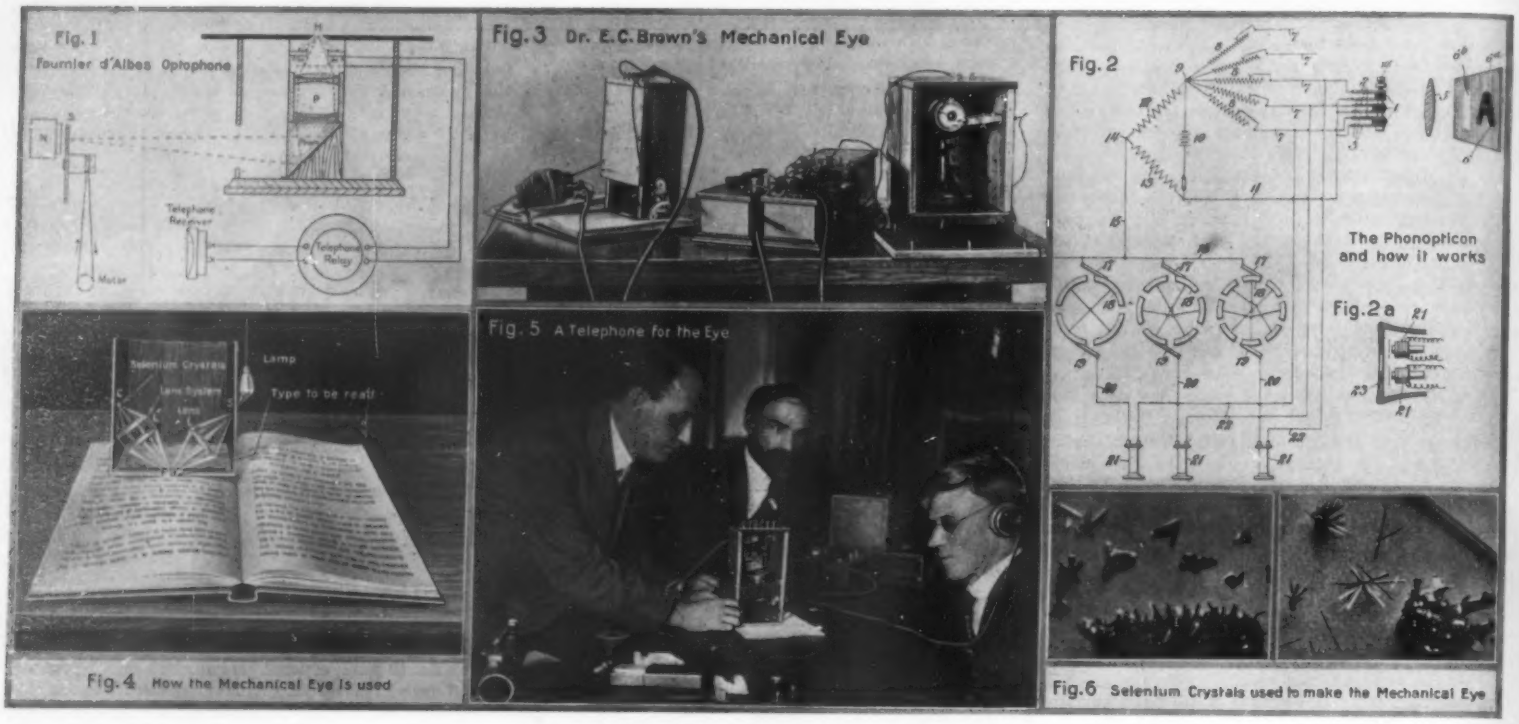
A Solar Observatory in Australia.—At the Dublin meeting of the British Association for the Advancement of Science in 1908, a committee was appointed to work for the establishment of a solar observatory in Australia. This object will shortly be attained, as the commonwealth government proposes to establish an astronomical institution at the new federal capital, Camberra, and a section of this institution will be devoted to solar physics.

A Beautiful Photograph of a Solar Halo forms a full-page plate in the May number of the *Monthly Weather Review* (issued July 30th). The picture was taken by Mr. C. N. York at New Haven, Conn., May 20th, 1915, on an 8 x 10 plate, exposed behind a "15-time" filter for 1/100 second. It appears, at first sight, to represent the common circular halo of 22 degrees radius, but closer examination shows the luminous curve to be distinctly elliptical. As stated in the accompanying text by Prof. C. S. Hastings, it is really what has been known in all standard treatises on atmospheric optics as the "circumscribed halo"—for which Prof. Hastings introduces the superfluous new name "oval of Venturi"—formed by the junction of the upper and lower tangent arcs of the halo of 22 degrees.

The So-called "Dark" Companions of Algol Variables are probably in all cases self-luminous, nor is there necessarily any great difference in brightness between the two components. A recent memoir by Mr. Harlow Shapley, dealing with these eclipsing binaries, says that their minimum in every case represents "a total eclipse, and not an annular eclipse by a completely dark satellite. The brightness of the components of a close binary is not more unequal than in visual doubles, and no disparity of the order illustrated by Sirius and Procyon is known to exist among eclipsing variables. In fact, in all but five or six systems we have positive evidence that the fainter star is self-luminous, and in no case is it necessary to assume one component completely black. In about two thirds of the systems the difference does not exceed magnitudes, and no observed difference is greater than four." Thus the statements relating to Algol and its congeners in all recent general works on astronomy require modification.

A Brilliant Daytime Meteor was observed by thousands of persons in the south of England on July 5th, at 8:30 P. M.; i. e., a few minutes after sunset. In a preliminary account of this meteor, published in *Nature*, Mr. W. F. Denning concludes from a comparison of observations at several points that the object passed over the English Channel from south of Plymouth to Boulogne, France. When first seen its height above the earth was 57 miles, and when last seen 28 miles; the length of its visible path was 260 miles; and it traveled at a speed of 20 miles a second. During its passage its nucleus was seen to disintegrate "into a series of glistening balls strung on a fiery cord." The remarkable brilliancy of this meteor is shown by the fact that, although its flight occurred in strong daylight, it "brightly illumined the sky and attracted people to look upward to ascertain the cause." Mr. Denning remarks on the fact that very large meteors apparently exhibit a preference for the early evening hours.

The Number of Naked-eye Variable Stars has recently been computed by Mr. Harlow Shapley, and is much larger than was supposed a few years ago. According to Mr. Shapley's enumeration, there are 5 variables of the first magnitude or brighter, 2 between the first and second, 8 between the second and third, 20 between the third and fourth, 22 between the fourth and fifth, and 49 between the fifth and sixth, making a total of 106. This is about 3 per cent of the total number of stars (3,330) visible to the naked eye. Moreover, these figures do not include a number of bright stars which have recently been suspected of small variation by Lau and Guthnick, although, says Mr. Shapley, many of them will probably be admitted soon to the list of known variables. If these were included the percentage of naked-eye variables would be increased from 3 to more than 5. As to the types of variability, the 106 stars in Mr. Shapley's list include 27 long-period, 18 short-period, 18 eclipsing, and 43 miscellaneous variables. The miscellaneous class includes variables with unknown or irregular periods and the Novæ.



The mechanical eye and how it sees.

A Mechanical Eye

Bringing Sight to the Blind; A Description of the Crystal Phonopticon

By L. E. Dodd

SEVERAL years ago the public was first acquainted with an apparatus devised by Fournier d'Albe to enable the blind, by means of auditory impressions, to detect the varying intensity of light in their neighborhood, and thus to guide themselves to light sources, to know when they were entering a shaded place, or when night had fallen or day had dawned. The operation of this instrument, wonderful enough at the time of its invention, depended on the outstanding property of the element selenium to change its electrical resistance according to changes in the intensity of light falling upon it. In other words, for a given light intensity applied to the element it presents a corresponding resistance to the passage of an electric current through it. This apparatus, while marking an epoch, was hardly of sufficient practicability to be in demand by many among the blind.

The Optophone of d'Albe.

Only a little over a year ago there was read before the Royal Society of London a description of an apparatus called a "Type-reading Optophone," also invented by Fournier d'Albe. It was a marked development from the device already mentioned, and a modification of a prototype described by d'Albe the year preceding. By the use of this prototype one could differentiate certain letters, which, however, had to be transparent and illuminated by transmitted light. Moreover, it was necessary that the height of the letters be as much as five centimeters.

To quote from the original paper: "The audible telephone circuit was produced by intermittent light of various musical frequencies, and by using eight such frequencies, emitted by dots placed in a row, it was found possible to read transparent letters—by learning to recognize the characteristic sound of each letter." The later modifications of this prototype, which made the device applicable to the printed page, will be best appreciated from the further words of d'Albe (see *Proceedings*, Royal Society, 1914):

"In order to adapt this experimental instrument to the reading of ordinary letterpress by means of the ear, three further modifications were necessary:

"1. The length of the line of luminous dots had to be reduced from 5 centimeters to about 1.5 millimeters, the size of ordinary type.

"2. The light had to be used after diffused reflection by the printed surface.

"3. The sensitiveness of the telephone arrangement had (as a consequence) to be greatly augmented.

"These modifications have now been made, and an instrument has resulted, which, with some practice, enables totally blind persons to read ordinary books and newspapers through the sense of hearing. It consists of a small siren disk *S*, Fig. 1 (reproduced from the volume mentioned) illuminated by a straight Nernst filament *N*; an optical arrangement for projecting an image of the line of luminous dots furnished by the revolving disk upon the type to be read; a set of selenium or antimonite bridges exposed to the light reflected by the type; a Brown telephone relay connected with these bridges; and the telephone receiver used for reading.

"The optical arrangement consists of a right-angled prism which directs the horizontal beam of light coming from the siren disk upward through the short focus portrait lens *P* on to the small aperture *H* in the flat slab upon which the sheet of letterpress is laid face downward. The focal plane of the line of dots coincides with the upper surface of the slab and with the printed sheet. The selenium bridge is placed as close as possible to the print, and is perforated to allow of the passage of the incident light. The siren disk is driven by an electric motor or train of wheels actuated by a weight. Constancy of speed is desirable, but not wholly essential. When this is done, and a printed sheet is passed over the slab, the maximum sound is heard in the telephone when the paper exposed is white, and the minimum when it is black. The actual sound heard depends upon the shape of the letter. The small line of dots, 1.5 millimeter long, is made to illuminate each letter in turn, the print being moved steadily in the direction of the printed line, which is at right angles to the luminous line of dots. The print is so adjusted that the line of dots just covers the maximum height of the type used. The dots should be at least eight in number, six for the body of the letter, covering the whole height of such letters as *a* and *e*, and one dot each for the upper portion of such letters as *f* and *k*, and for the lower portion of such letters as *p* and *g*. The note of each dot must be chosen so that it is easy to recognize its *omission* (not its *presence*, as in the case of the reading optophone previously described). Good results have been obtained with a set of notes with which both concords and discords can be obtained, according to the letters exposed. . . . A simple focussing device enables the operator to alter the length of the line of dots, and so adapt it to various sizes of type. It is essential, in reading a line of type, that the alignment be perfect. This is ensured by a sliding device on the reading slab."

This somewhat detailed description of Fournier d'Albe's apparatus has been presented to give the historical setting for the further development of a more perfect instrument by which the blind can read the printed page.

Brown's Crystal Phonopticon.

In the crystal phonopticon recently devised by Dr. F. C. Brown of the State University of Iowa, use is made for the first time of individual crystals of selenium, which Dr. Brown, with others of the Physics Department of that institution, initially produced. By these crystals the problem has been tremendously simplified, indeed finally solved. Some idea of what has been accomplished in a very few months toward making a print-reading device thoroughly practicable for every blind person, in fact a necessity rather than a luxury, may be gained from the few facts which follow.

On the first and second of July of this summer Dr. Brown exhibited his apparatus before the annual convention of the American Association of Workers for the Blind, held at San Francisco. Out of some thirty blind persons tested, all, in but two or three trials, could distinguish with certainty such letters as *A*, *W*, *L*, *O*, *I*. Mr. D. S. Weider, in charge of certain work in the shops for the blind at the University of California, himself blind, learned to distinguish a large number of letters with extreme ease, and without any previous experience with the phonopticon. The three words, "at," "the," "nine," were given him. Having heard them only twice he could distinguish these words without failure. They were in print of a size having 3-millimeter capitals. In the opinion of Mrs. Rider, in charge of the Literature for the Blind at the Congressional Library, Washington, D. C., Mr. Weider's reading of the words was "surprisingly rapid." Mr. Weider, quickly grasping the idea of the phonopticon, offered to assist in the demonstration by illustrating on the pipe organ the sounds of different letters. For example, the letter *W* would have a sound similar to the successive notes me-do-me-do-me, while *A* would sound like do-me-do. This will be better understood after a description of the phonopticon has been given. The most interesting and exacting test came when Miss Rider suggested that, with Mr. Weider at the phonopticon, a letter unknown to him, and one that he had not previously heard, should be given him. This was done, and having requested a second hearing of the letter, Mr. Weider named the correct one. Dr. Newell Perry, himself sightless, in charge of teaching work at the State School for the Blind at Berkeley, and president of the National Society for the Higher Education of the Blind, has become one of the most interested in the new invention. In fact he has been closely following its development. He found little difficulty at the San Francisco convention, where he had his first opportunity of using the instrument, in distinguishing letters. It is estimated that in two months' time a blind person of average ability can learn to read with the phonopticon.

Description of the Phonopticon.

Fig. 2 shows schematically the working of the instrument. The page, bearing the letter *A*, for example, lies before a lens. The page remains stationary while the lens (5) and the selenium crystals (1) are moved together over the line of letters. A bright band of illumination (6b), whose source is not shown in the diagram, moves with the lens and illuminates strongly each letter in succession. Let the band of illumination be in the position indicated, and approaching the letter *A*. As the successive parts of the letter come into the light their images are thrown by the lens on the corresponding crystals; the upper crystal will receive the successive images of the lower parts of the letter, the lower crystal those of the upper part of the letter, and the central crystal the images of the central parts. The lower left part of the *A* enters the illuminated region first, and the upper crystal will be the first to respond. Next, the central crystal will respond, and by the time the lower crystal is reached, the upper one will have ceased to respond, as the lower left part of the letter has passed out of the region of illumination. The central crystal will continue to act, due to the continuance in the band of the horizontal line of the *A*. As the letter passes on, the lower crystal will cease to respond, because the apex of the *A* has passed out of the band. Next, the central crystal will cease to act soon after the upper crystal responds to the entrance into the

(Concluded on page 147.)

"Double-ender" Military Locomotives

By Herbert T. Walker

THE Baldwin Locomotive Works has recently built 107 locomotives for the French government, to be used in moving heavy artillery and for general switching purposes on exceptionally rough track with sharp curves and other conditions unfavorable to the use of engines of ordinary design.

The accompanying illustrations show both sides of one of these interesting locomotives, by which it will be seen that they are of the "double-ender" variety originally introduced by Horatio Allen in 1831, but developed and much improved upon by Robert F. Fairlie in 1866, since which time this design of locomotive has generally gone by his name. It never came into extensive use in this country and probably never will—the "Mallet" system being much better adapted to our requirements.

Referring to the illustrations, it will be seen that the wheel arrangement is 0-4-4-0, and that the two boilers are united at their fire-box ends, both fire-boxes being inclosed in a single outside shell and surmounted by a single high steam dome. Each fire-box has its own fire door, the fire-boxes being separated by a water space about 2 inches wide, and both communicating by a separate set of tubes to a smoke-box and stack at each end of the boiler.

Fig. 1 shows the engineer's side of the engine. Fig. 2 illustrates the fireman's side, showing the reversing lever which controls the four sets of reversing motion simultaneously. The driving wheels are 25.5 inches in diameter and are mounted in swiveling bogie frames placed outside the wheels. As all the wheels are drivers and the wheel base is articulated, these engines have great hauling power with extreme flexibility.

The boiler barrels are supported on saddles placed above the bogie center pins, the fire-box resting in a cradle of two plate frames which are riveted to the saddles. The steam pipes leave the boiler through openings in the bottom, and by ball joints pass through the bogie centers. Each pair of cylinders comes directly under its respective smoke-box, and a ball jointed exhaust pipe communicates with the smoke stack.

The water is carried in four side tanks, all connected by equalizing pipes. The two tanks on the fireman's side are shorter than the others to provide space for coal bunkers. There are two throttle valves in the steam dome, each connected to a pipe leading to one of the bogies. There are three throttle levers, two of which operate both throttle valves simultaneously, and are so placed that one of them can be reached from any part of the cab. The third throttle lever is normally latched to the others so that steam is admitted to all the cylinders simultaneously; but if it is desired to run the engine with one half of its power the third throttle lever is unlatched and steam admitted to only one pair of cylinders.

The springs are of special design, having rubber washers to absorb shocks, so that these engines are very easy riders, there being practically no jar or lurching when traversing curves with an uneven track.

These peculiar locomotives are of the Pechot type. They were originally introduced in 1888 and reflect great credit on their designer. The track gage is 1 foot 11⅝ inches and the engines in working order weigh 28,100 pounds. The cylinders are 6.88 inches in diameter by 9.44 inches stroke. The valve gear is the Walschaerts motion.

These engines were built to very rigid specifications prepared by the French engineers, and they were finished in a remarkably short space of time. The order was received February 1st, 1915; forty engines were shipped on March 31st, and the last one left the works on April 24th.

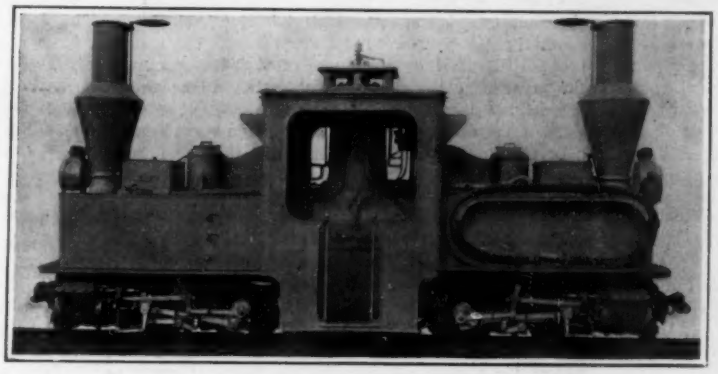


Fig. 1.—Engineer's side of the French double-enders.

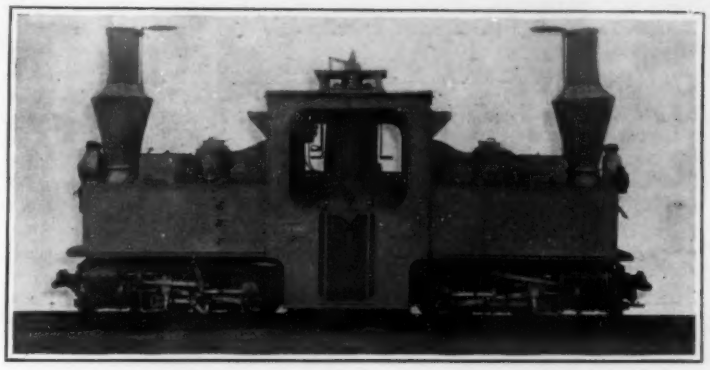


Fig. 2.—The fireman's side, showing the two fire doors.

Hedge Screen of Mesambryanthemum

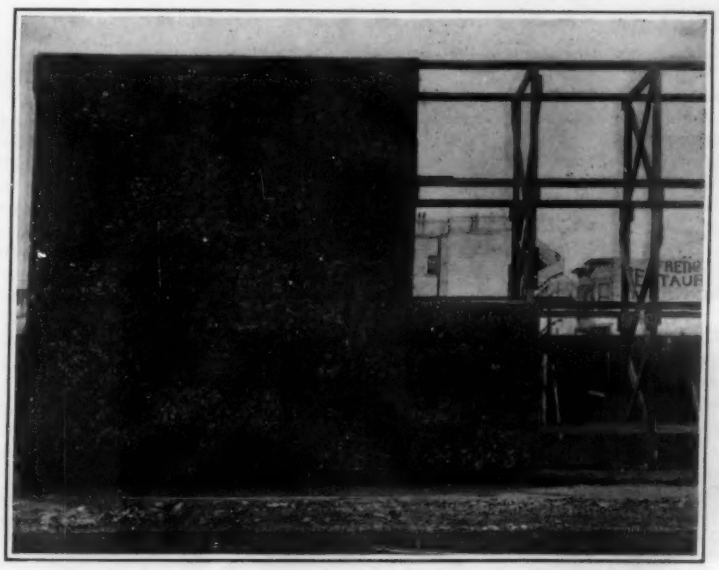
A HEDGE composed of tiny star-shaped pink blossoms, 20 feet in height and 1,155 feet long, will extend for two city blocks on either side of the main entrance to the grounds of the Panama-Pacific Exposition.

The manner of building this hedge is unique. The plants, which are similar to the well-known "ice plant," are grown in boxes containing only two inches of soil, across the top of which wire screening is fixed, to hold plants and soil in place. When the vines have reached a sufficient growth, the boxes are set on edge, so that the roots are fixed in a vertical layer of soil. A sort of wall is then builded of the boxes, much as though they were huge bricks or stones. The effect is of a vertical cliff or hedge of living green and pink.

The photograph shows the framework to which the boxes are secured, and the manner of constructing the hedge, but gives little idea of its beauty.

This wall of flowers will be broken at intervals by pilasters, with pedestal and capitals in architectural dimensions, which will also be covered with the same screen of living plants.

A pipe running along the top of the framework will supply water to the plants in such a manner that they will have the appearance of being gemmed with dewdrops. Donald McLaren, acting director of exposition landscaping, is the designer of this hedge.



Hedge screen built of plants in boxes.

The Current Supplement

HOW do objects appear to the eye of a fish, and how would they look to the human eye if placed under water? This is an interesting discussion that will be found in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2067, for August 14th, 1915. This question has received but little attention, and it involves a number of considerations of the distribution of light beneath the surface and the graduations of color to be expected at different depths. The article is illustrated by a number of photographs and diagrams. The Prevision of Earthquakes takes up a problem of great importance in many parts of the world, and examines the conditions from which seismic disturbances may be foretold. Trenches and similar methods of defense are so frequently discussed that the short illustrated article on the subject, describing and picturing some of the devices used will be acceptable. We all think we know all about dust, but there are many distinctions, causes and results that seldom occur to us. A reading of the paper on this apparently simple subject will bring much useful information. High explosives are so frequently discussed in connection with the war that many lose sight of their many every-day uses, or of the variety of the substances employed and their composition. There is a most instructive article on the subject in this issue, accompanied by a number of photographs that give a good idea of the power and results of an explosion. This number also contains a most excellent description of the construction of a vibratory rectifier, for wireless work that is so fully explained and illustrated with detail drawings that a clever experimenter should have little difficulty in building the apparatus. It will be most valuable to the wireless enthusiast. For the protection of vessels traversing the North Atlantic Ocean an arrangement was made several years ago by several nations to establish an International Ice Patrol to guard that region during certain portions of the year, and the service has so far been maintained entirely by the United States, two revenue cutters having been on duty each season since 1912. During the cruises of these vessels much valuable information has been gathered, and some of the facts are given in a recent report, from which extracts are quoted. The unusual paper, "Is Organism Thermodynamics," is concluded. Other articles tell of John Muir's life at college; zinc extraction by electrolysis; problems of airship design and construction; tests of car resistance; agricultural lime, and several other subjects.

Lack of Chauffeurs Worries Russia

WHATEVER may have been the causes of the withdrawal of the Russian armies from their strong positions in Galicia and Poland, there now remains no doubt that one of the strongest must have been the lack of chauffeurs capable of driving the American motor trucks. Advertisements appearing in British and Canadian papers—yes, even in Detroit and Toledo papers—offer high wages to motor truck drivers "willing to go to Europe for not less than one year" as the advertisements in America and Canada state! Russia, of all the fighting nations, has been most handicapped by its lack of motor equipment, by its poor roads and its lack of chauffeurs. Hundreds of good drivers have fallen in the hands of the Germans, while the rest have to conquer great obstacles before they can render valuable services.

Less than ten per cent of the entire Russian people are acquainted with motor traction, even in the most superficial manner. Not more than one per cent are able even to handle a motor vehicle, much less repair it! And as for really good drivers for this hazardous and difficult work of keeping huge armies supplied—Russia has less than 5,000 men! The motor vehicle plays an important rôle in all the fields of battle, but when the history of the war comes to be written it will be found that its most spectacular and most clearly visible effect has been the paralysis of the Russian masses as compared with the flexibility of the well-equipped German-Austrian armies. In the Western field the army truck is a valuable addition to the railroad and to the horse-drawn supply train. In the Eastern battlefields its presence or absence—its smooth working or its breakdown—represent the difference between victorious advance and precipitate retreat. It is in the rapid marching of the Russian campaign that the motor truck really shows its full value and full capacity as a military weapon.

Strategic Moves of the War—August 4th, 1915

By Capt. Matthew E. Hanna, Recently of the General Staff, U. S. A.

As these notes are written (August 4th) German strategy apparently is about to win the first great decisive victory of the war. The circle of fire is being pushed ever closer about Warsaw, and from south, west, north and northeast Teuton forces are driving with all their might against the Russian forces defending Poland. The world audience is witnessing what promises to be the successful termination of the most masterful strategic plan of all military history. If we properly interpret the events in this theater during the year the war has continued, the situation on the Russian frontier to-day has not merely "happened" and taken its present form, so favorable to the Teutons, through mere lucky chance, but has resulted from the deliberate planning of the German General Staff and consistent adherence to its plans during the entire year of war.

Poland projects into German territory like a huge fist aiming its blow at Berlin. On three sides it is bordered by German territory. To the north is the narrow strip of East Prussia, less than one hundred and fifty miles wide, bordering on the Baltic Sea. To the south is the Austro-Hungarian province of Galicia, traversed from east to west by the Carpathian Mountains, one hundred to two hundred miles south of the Polish frontier. From the Baltic Sea in the north to the Carpathians in the south the distance is less than four hundred miles at the narrowest point—a line none too long for an efficient offensive campaign by Russia's hosts, and on this front she could advance against the heart of Germany with her right flank protected by the Baltic Sea and her left by the Carpathian Mountains. In the successful prosecution of such an advance, Poland, and more particularly the great city of Warsaw with its manufacturing facilities and splendid railroad communications, with the interior of Russia on one side and with the German frontier on the other, would form a military asset of very great value. Much has been written in the last few weeks of the purely accidental way in which the Russians have been led into a defense of Polish territory, but this reads more like an apology for the disaster which threatens them than sound military strategy, and is difficult to reconcile with the struggle they have made to hold this territory in the face of very great hazards.

More probably Russia has looked upon Poland, until quite recently, as a great base of operations for a decisive campaign against Germany, the leader of the Teuton alliance, and in surrendering it she is giving up strongly defended territory which must be recovered before Germany can be invaded, or, in other words, before the war can be terminated decisively in favor of the Allies. The conquest of Poland would be a stupendous victory for the Teutons, not so much because of what they would gain as because of what the allied cause would lose.

For months, while Germany was fully occupied in the western theater and Austria was left to struggle quite alone in the eastern theater, the Russian army made repeated efforts to advance its two wings through East Prussia on the north and Galicia on the south, and bring them on line with the center in Poland, for the center would have been in still graver danger had it been thrust farther toward Germany before the two wings were up and the whole line straightened out from the Carpathians to the sea. Despite the demands made on Germany by her campaign in France, she was able to keep a fairly strong force in East Prussia at all times, and by means of her admirable railroads has always succeeded in sending re-enforcements to this region from France in sufficient numbers to check and then drive back the Russian forces that have penetrated East Prussia from time to time. As a result, the Russian offensive north of Poland has never met with any lasting success.

To the south of Poland, in Galicia, the Russian advance was most successful throughout the first nine months of the war, and was not stopped until practically all Galicia had been conquered, the Carpathians crossed and Hungary imminently threatened with invasion. From time to time during this period Germany had bolstered up the failing strength of her ally with such troops as she could ill spare from her western campaign, but never without doing little more than check the victorious Russian onslaught and prevent it from reaching a phase beyond all control. Fortunately for the Teutons, before this could happen the Germans were able to dig themselves so securely into the ground, from the North Sea to Switzerland, that they could safely transfer the bulk of their forces from the west to the east and turn against Russia as the giant first to be destroyed. This was in April. For nine months the Teutons had struggled to hang on to the territory north and south of Poland, partly to prevent Russia from securing the great benefit that would be hers if she could form her army on a straight line from Danzig south through Cracow to the Carpathians, but mainly because this territory was to be of vital importance in the great offensive campaign ultimately to be waged against Russia.

The great central idea of this campaign was to entice a part of the Russian army deep into the bag formed by Poland and strive by every conceivable stratagem not only to keep it there, but to add to its strength from day to day, while in the meantime planning and executing arrangements to bring the campaign to a decisive climax by closing the mouth of the bag east of Warsaw. When Germany set out to do this, in April, she held all of East Prussia and was in the desired position north of Poland, but to the south the Russian army must be pushed back nearly two hundred miles through Galicia before the Teuton advance against Warsaw could be made advantageously from this direction. At that time the Russian line ran almost due south through western Poland, passed to the east of Cracow, crossed the Carpathians (south of the southern edge of the map), and

The closing in of the Teutonic lines upon Warsaw.

then bent to the eastward. With a thoroughness not excelled in any previous war, Germany now made her preparations for the first stage of the colossal campaign which is reaching its climax as these notes are written.

From the French battle front, from all parts of Germany and from the northern portions of her line in Russia she assembled men, artillery, ammunition and war supplies of all kinds in the region of Cracow, and when all was ready began her impetuous drive through Galicia that was scarcely checked until practically all Galicia had been recovered and the Russian line had been bent well back to the eastward on the south of Warsaw, and the bag for the capture of a part of the Russian army had been formed.

This ended the first stage of the campaign, and with the same thoroughness as before, arrangements were made for the second stage, which was to be a simultaneous advance from north and south in the general direction of Brest-Litovsk to close the mouth of the bag. Again there was a considerable period of comparative calm, probably utilized by the Teutons in shifting their troops for the changed direction of the attack, and in bringing up ammunition and supplies. The reports indicate that the operations preliminary to the decisive advance now in progress were so skillfully managed that the Russians played into the Germans' hands by moving strong re-enforcements into the Warsaw region and thereby adding to their disaster should the German advance be successful.

Some months ago the Germans captured the port of Libau, on the Baltic Sea. Little notice was taken of this at the time, for considered as an isolated operation it was not deemed important, particularly in the face of events of vast magnitude and importance taking place elsewhere at that time. More recently they have captured the port of Windau, a little farther north on the coast, and the German troops in this region have been greatly re-enforced. It was suggested in these notes some weeks ago that this army probably was being collected in this district for some important mission at a later date, and it now turns out that this force may be the final decisive factor in the campaign, placed in its present strong strategic position at an opportune moment long before the campaign had assumed its present critical stage. It was not possible to support a large force in this region without first capturing the two coast towns of Libau and Windau and getting possession of the railroads leading from them into the interior. Overland operations into this region by forces moving from East Prussia were not practicable because of the lack of railroads between the frontier and the Libau-Vilna Railroad, seventy-five to one hundred miles from the frontier.

It needs but a glance at the map to see the important strategic position the Germans have thus secured on the northern wing of the Russian army. This greatly broadens the possibilities of the campaign, while materially increasing Germany's chances for success in the campaign. A German advance from this region endangers the important railroad running from Warsaw to Petrograd and threatens to envelop the right wing of the Russian army in such manner as to cut it off from Petrograd and compel it to withdraw much farther east than would be necessary if its right wing were securely anchored on the Baltic Sea.

No doubt the Russian plan from the beginning of the war has been to occupy a general north and south line through Brest-Litovsk in case it became necessary to abandon Poland. The left wing of the army would then be strongly posted on the Dniester River (just south of the territory shown on the map), the center would be behind the Bug River and the powerful fortifications of Brest-Litovsk, and the right wing would be fully protected by the sea. The total length of this front is approximately five hundred miles, and the Russian army would be capable of defending this line quite as stubbornly as the French and English have defended a somewhat shorter line in the west. But with the Germans in full possession of the Baltic coast as far as the Gulf of Riga, the Russian right wing must bend sharply to the eastward, pivoting on Brest-Litovsk, and will be "in the air." A continuation of the German advance from the general direction of Riga might bend back this wing of the Russian army to such an extent as to form another prominent salient in their line at Brest-Litovsk similar to that now existing at Warsaw. The operations of the German army to the south of Brest-Litovsk are also tending to produce this situation. The Germans have succeeded in crossing the Bug River and are pushing toward Kovel, so that while completing the circle about Warsaw they are at the same time beginning to weld a ring around Brest-Litovsk.

If the Germans continue to meet with success in this campaign, its further development probably will be divided into two distinct stages, the first of which will terminate with the capture of Warsaw and the conquest of Poland. The Russian line cannot make another stand before reaching Brest-Litovsk, and from here it probably will run about due north through Vilna. After a period of some days—for recuperation and rearrangement of troops—we may see the Germans begin the second stage, consisting of a wide turning movement to the north of Vilna against the Russian right wing, which would rival in magnitude the initial drive of the Germans through Belgium and northern France against the French army in front of Paris. And here, as in France, the purpose of such a drive would be the destruction of the army opposed to them. If the Russians should prove to be not strong enough to hold the strongly fortified region of Poland, there is much less chance of their being able to hold a weaker second line, especially if their losses in Poland should be out of proportion to those borne by the Germans, as most probably will be the case if the Russians must abandon the Warsaw lines. More than ever before will Germany be confronted with the necessity of continuing the Russian campaign, if she is to get the full benefit of her previous victories. The time when she can once more turn her attention to her western front in France still appears to be far away.

The world continues to wonder why the Allies in the west cannot do more to relieve the pressure on Russia. Italy is doing her share with her steady pressure on the Austrians along the Isonzo, and is preventing reenforcements being sent from this theater to aid the Teutons in Russia, but we hear persistent reports of German troops being withdrawn from in front of the French and English to operate against Russia. If the

Allies in France are not strong enough to prevent this being done, with Germany's lines in this theater already greatly weakened, what will they do if Germany eventually is able to shift a million or more men to the west and undertake a second drive on Paris much more powerful than that of the first weeks of the war? The inactivity of the western Allies may be satisfactorily explained when all the facts eventually are known, but with the information before us now, we cannot avoid the conclusion that there is lack of co-operation between the Allies on the two great battle fronts. More than once in the opening months of the war, when France was undergoing her supreme trial, Russian activity in the east saved France at critical stages of her campaign. But for three months the fortunes of war have steadily gone against Russia, until to-day she is confronted by a situation so critical as to threaten disaster not only to her main army, but to the entire allied cause, and yet France and England are doing nothing out of the ordinary, so far as the world can see, to checkmate the German success in the east.

The great war has entered its first decisive phase, and for the present the balance hangs low in favor of the Teutons But the Russian army is still intact and far from being destroyed. If it can save itself from disaster in the next few weeks, if Italy can continue to press forward on the Isonzo, and if France and England can begin operations that are up to the expectations of the world, winter may see the balance of strength restored and the contending forces on an equal footing for a fresh start.

A New Discovery in the American Wine Industry

THE American Department of Agriculture announces that there has been discovered at Washington, a method for concentrating grape juice, which promises to be the greatest discovery in the wine industry since Pasteur discovered the method of preserving light wines for the French government.

This new method is altogether novel, as it consists *not in boiling* down the juice, *but in freezing* the juice. The ice is then cracked into small pieces and whirled in a centrifugal machine; by this means all the sugar and thick syrup is separated from the ice, which is almost pure water. By this means a gallon of the syrup is reduced to one quart.

A peculiar phenomenon incident to this process is the fact that the cream of tartar crystallizes out with the ice and makes the acidity of the juice much less than normal. This is particularly true of the Concord grape juice, which has a large percentage of tartar in it.

This new method of freezing the juices to concentrate them preserves in a wonderful degree the natural purple color of the juice and makes the drink very much more beautiful in its rich purple appearance and more sparkling.

When the concentrated juice is sterilized afterward by heating it keeps indefinitely as a thick syrup. It can be used at soda fountains, as flavorings for cookery and other dietary purposes. The Government hopes to exploit this latest discovery on a commercial basis this year, as it promises not only to give a fine quality of goods from the best grapes, but also the freezing method takes out the "rough" taste of many cheaper grades and gives a very fine article from the cheaper and coarser varieties.

The Work Done by German Guns

THE cartridge used in the German infantry rifle, marked M 98, contains 3.2 grammes, or about 0.112 ounces avoirdupois of powder, which on explosion creates 2,762 calories, or 10,960 British thermal units, corresponding to 1,170 kilogramme-meters, or 8,463 foot-pounds. Of this one third is utilized in creating the initial velocity of the bullet of 820 meters, or about 2,690 feet per second, and in imparting the rotative motion. One quarter of the energy is lost in heat to the barrel and 45 per cent passes away in sound energy and the escaping gases. The bullet passes out of the barrel in 1/200 of a second, and during this time a pressure of 5,600 atmospheres, or 51,450 pounds per square inch is acting within the barrel.

The largest guns used on German warships have a bore of 40.6 centimeters (16 inches), and the firing of one of these guns represents 41,500,000 kilogrammemeters, or 300,000,000 foot-pounds. This is equal to the impact that would result from the fall of a block of granite 30 feet long, 30 feet wide and 20 feet thick dropped from a height of 110 feet.

The 30.5-centimeter (12-inch) Krupp gun fires a projectile weighing 445 kilogrammes (981 pounds), which leaves the barrel with a velocity of 2,690 feet a second. Their maximum range is 20 kilometers, or about 12½ miles, and the shot covers this distance in 95 seconds. If one of these guns is fired in a due north and south direction the projectile will deviate a distance of 160 meters, or 525 feet from its true direction, owing to the revolution of the earth.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Lightning Without Rain

To the Editor of the SCIENTIFIC AMERICAN:

A peculiar lightning display occurred here on the morning of Tuesday, June 22nd, which I should like to ask you to explain, if possible, and also ask if similar displays are at all common.

There had been a severe thunderstorm accompanied by heavy rain between 1 and 2 A. M., but by daylight the rain had stopped. Tuesday morning was cold and damp, with a very cloudy sky. At about ten minutes after 11 A. M. there occurred a most terrific lightning display over an area about half a mile wide and over a mile in length. "Lightning balls" and flashes were seen all over this area, and at the same instant there was a tremendous single thunder clap that sounded like an explosion of dynamite. There were no reverberations of the thunder.

I was on the ground floor of my home, which is near the center of the area affected. I saw a flash in the hallway resembling the discharge between the points of a high power induction coil, and heard a sharp crackling sound above the noise of the thunder or else immediately preceding it. On both second and third floors of the house "lightning balls" were seen passing down the hallways, as well as one in the kitchen in the rear of the house. For a few moments afterward there was a distinct smell of ozone in the air. No damage whatever was done except that the lightning arrester of the telephone was blown out.

Exactly similar effects were noticed at houses a quarter of a mile to the north and a quarter of a mile to the south of my home, and at many places in the town of Freeland, about a mile to the east. Several 'phones were blown out. In one case of three 'phones on the same line, two were blown out, while the third was not. The telephone operator at the Freeland exchange said that "balls of fire" issued from most of the plugs on the switchboard. Persons who were out of doors at the time describe "balls of fire" dropping from the sky and exploding on hitting the ground.

Everyone describes the noise of the thunder as being "close at hand" and coming at the same instant as the lightning.

No damage was done except the slight injury to the telephones, and no one was injured. No rain fell at the time, and we had no further electrical disturbance until about half past three in the afternoon, when we had another fairly severe thunder shower.

If you can throw any light on this occurrence I shall esteem it a great favor. E. J. D. COXE.

Drifton, Pa.

[A discharge of lightning without rain is unusual but not rare. During rapid convection, electrical separation is produced in such manner that the larger rain drops usually become charged with positive electricity and the smaller with negative. Hence, even after the generation of electricity has ceased the remaining cloud is likely still to be highly charged and thus capable of producing a final flash.

The "balls of fire" on the telephone switchboard, and probably most of those seen at other places, doubtless were either ramifications of the main discharge or else return discharges due to the sudden change of potential caused by the first flash.—EDITOR.]

A Former Patent Commissioner on the Patent Office in the Old Days

To the Editor of the SCIENTIFIC AMERICAN:

I am advised that you are about celebrating the seventieth anniversary of the SCIENTIFIC AMERICAN. Your latest issue lies upon my desk. It is almost exactly a half century since I received the first. It was young then, but fresh and interesting and instructive every week. Increased in scope, it has kept pace with the years, and I still read it with unabated interest. But I recall the fresh impressions formed in those early years, and I particularly remember your representatives in Washington, of those earlier years, the Knights and Gridley, men of ability and high character and service, well continued in their successors.

This anniversary brings to my mind a flood of reminiscences of a half century ago.

Compared with its present admirable condition, everything in the Patent Office of that time appears to me now to have been rather crude. In the class of railway and civil engineering, in which my lot fell, there were three of us, an examiner, a first assistant and myself, then a raw recruit metamorphosed from a veteran commander of a brigade, in theory into an acting second assistant, then the lowest grade.

But everything was new to me and intensely interesting. My duties as second assistant included the keeping of the books and care of the files. Examiners' clerks had not then been invented. This clerical work, however, occupied only the morning hours, and the remainder of the day was devoted to examination of applications. In my case it also included much study, as there had been nothing in the Army Regulations and Casey's Tactics, the text books of the previous years, which was applicable to the present business.

Fifty years ago the record behind us, the "state of the art," was a much smaller field and simpler. Yet of this we had comparatively scant records. In the examiner's room there was nothing excepting a few text books, no copies even of our own patents, and we were obliged, in making searches, to go to the draftsman's room and handle huge portfolios, pulled out from rollers and rested on the floor. Our principal examiner, when he applied himself to such labor, would bring down a huge assortment, and then see more critically what he could find in the mass. His acuteness varied, and toward the close of the month, if there were many cases on hand, remoter references were useful. The library was far less extensive and less available than now. One old librarian, who remembered enormously but principally by resemblances, did much to put us on unprofitable searches.

The examining corps had not then been selected by competitive examinations.

There was an examination, in strict propriety called a "pass examination," and if you were sent before it you "passed," not otherwise. The story was then told (and I believe it to be true—I knew the man) of one candidate who, when asked the distance of the sun from the earth, replied that he did not know, but was sure that it was so far as not to interfere with his duties as an assistant examiner. He "passed," and it is fair to say became afterward a principal examiner, and a good one.

There were many good men in the corps, notwithstanding the imperfect system.

There were two, or perhaps three, ex-governors of States. There were some graduates of colleges, but most of miscellaneous previous occupations. One principal examiner had acquired his fitness by reporting theatrical matters for newspapers. There were many bright young men, however, who by diligence and intelligence became expert. The great majority of these, as well as of the attorneys who then practised before the Office, are now, alas, dead. Of those who were in the examining corps in 1865, when I entered, only one remains.

Indeed, since that date the *personnel* of the Office has, in the main, many times changed.

I have observed the Office during all those fifty years, and without reflection on the men and methods of that early date, I know that there has been constant and now immense improvement both in material equipment, in *personnel*, and in methods. This has largely been due to causes within the Office, but the efforts of intelligent attorneys and the illuminating decisions of the courts have aided greatly also in bringing about an orderly and settled practice. ELLIS SPEAR.

Washington, D. C.

The Cryogenic Laboratory of Leyden

To the Editor of the SCIENTIFIC AMERICAN:

When reading your very interesting article on Prof. Kammerlingh Onnes's work in your issue of February 13th last, I remember having read in the English paper *Nature*, in one of the years 1895 to 1899, an article on the Cryogenic Laboratory in Leyden, with a small illustration of the very modest installation of that time, so I think it was not your paper that made first mention of said laboratory in the English language. In those times, Leyden being one of the four existing cryogenic laboratories, was worth mentioning for that reason only. Kindly compare the old illustration with your own recent ones, which will show the progress of that laboratory during that period. In the case you were not aware of the old article in *Nature*, I write you these lines, which might interest you. J. M. GEULS.

Bandoeng, Java.

Belgian and American Co-operation

To the Editor of the SCIENTIFIC AMERICAN:

I should be very glad if you would inform your readers that several Belgian competent business men have created an organization having a double object:

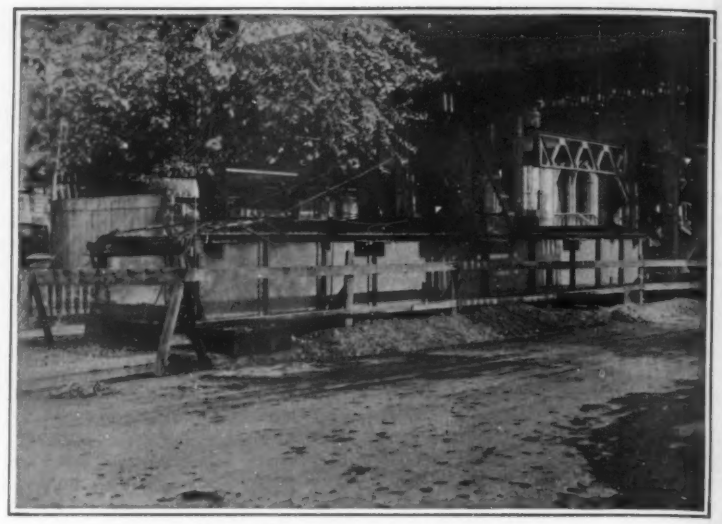
1. To introduce in Belgium, as soon as the war is over, all American products and manufactures, etc.

2. To employ as agents, representatives, etc., a large number of Belgian manufacturers and business men who have been partly ruined, but still possess enough capital and can give the necessary guarantees as agents, dealers, etc.

Being convinced that this organization will have the approbation of American manufacturers and business men, those interested are asked to address their inquiries to Mr. Willy Lamot, Shardhighs, Halstead (Essex), England, who will give them full details.

Halstead, England. WILLY LAMOT.

Shifting an elevated structure over to a new pier.



Skids used in sliding the track to a new alignment.

Railroad Building Under and Over the Streets of New York—IV

Reconstructing the Elevated Lines

IN the issues of July 10th, 17th and 31st, we described the new subways that are being built under the streets of New York and the tunnels that are being bored under the river. In the present and last installment of our series, we shall take up a number of points of peculiar interest in the work on overhead lines or elevated structures which are to form part of the Dual System of Rapid Transit. This construction has come in for much more popular attention, because being in the open, it gives one a chance to see the wizardry of the engineer. To be sure the work is not constantly menaced with the danger of a fall of rock or an avalanche of sand or a deluge of water, nevertheless much of it is extremely difficult because it involves the reconstruction of existing lines without disturbing the incessant traffic over them. This reconstruction is made necessary by the endeavor to avoid grade crossings and also by the building of a third track for express service on many of the lines.

Express Service on Elevated Lines.

Heretofore only on a portion of the Ninth Avenue line and on a part of the Third Avenue line has it been possible to establish a real express service running toward the business center in the morning and away from it in the evening. Now the third track of the Ninth Avenue line will be extended in each direction so that it will reach from 155th Street to Cortlandt Street. On the Third Avenue line express service will be maintained from Chatham Square to Bronx Park, and the Second Avenue line is now to be provided with a third track from Chatham Square to the Harlem River. Brooklyn, which has never had a third track system, will now have a real express service from Brooklyn Bridge to East New York, on the Fulton Street line, from Williamsburg Bridge to East New York, on the Broadway elevated line, and from Broadway to Ridgewood on the Myrtle Avenue line.

Double-deck Elevated Stations.

Particular interest from an engineering point of view attaches to the method of providing access to the third track of elevated lines in Manhattan. In some places there is room for an island platform between the local tracks and the central express tracks. But in the majority of places this is out of the question, and, instead, "overgrade" stations are being used. At the point where express stations are to be located, the central track is raised to a level of usually 11 feet 6 inches above that of the track at each side. Then a double-deck station is built, with the upper station platform extending over the local track to the central express track, as shown in Fig. 2, page 143.

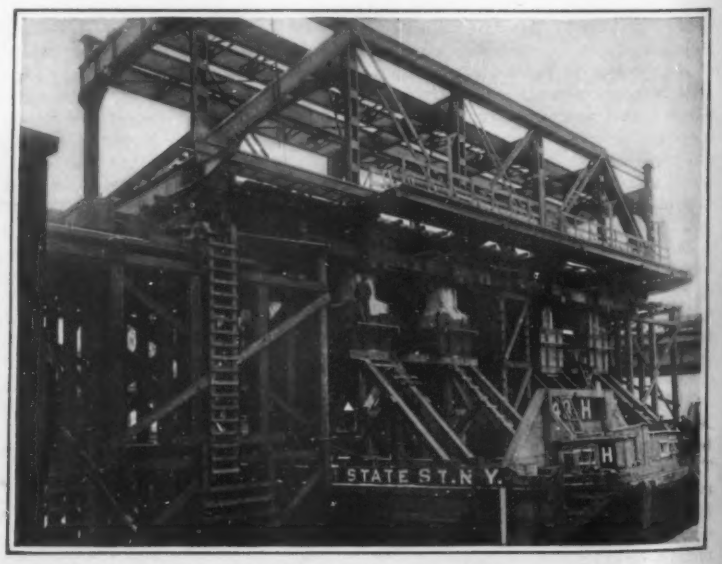
These undulations or raised parts of the express track should render the operation of the trains more efficient; for when the express trains come into a station they will do so on an upgrade which will help them to retard, while, on the other hand, on leaving a station, they will travel down grade, and this will help to accelerate the trains. Many years ago it was proposed to build an elevated railroad after this fashion, which would consist of a series of waves with the wave crests at stations. A serious objection to the system, however, was that it would involve the climbing of additional flights of stairs and hence would impose a hardship upon the passengers. In the present case, however, the additional elevation at stations is an absolute necessity and the undulatory system of tracking works in very nicely with this necessity.

Raising the Structure Seven Feet.

An interesting piece of work has been done at 125th Street and Second Avenue. Here a new station is being built, with two island platforms to provide access to the three tracks, and a mezzanine platform by which the island platforms may be reached. This station is to take the place of the former station at 127th Street. In order to provide room for the mezzanine platform it was necessary to raise the tracks about seven feet. Including the approaches to this raised portion the entire structure from 123rd Street to 128th Street, a distance of 1,400 feet, was elevated by means of jacks, without interrupting the traffic that was continually passing over that portion of the line. The method of doing this was to build temporary towers around each of the elevated columns, and then by means of jacks operating under the cross girders, the structure was raised a few inches over a length of about 250 feet. This produced a slight hump in the track which was barely noticeable. Then another section of track was similarly raised. Section by section the hump or wave progressed until the entire section had been raised to the elevation of a few inches above normal grade. This done a new wave was started raising the entire structure a few inches higher, and thus the jacking operations continued, step by step, until the new elevation was reached. The work was done in thirty-three separate jacking operations. The jacks, being placed under the cross girders, lifted the entire structure, including the columns and column bases. However, after each jacking operation, blockings were placed under the columns and between the cross girders and the timber tower, so that the structure rested on a firm foundation. By means of extension bolts, the columns were bolted down to the foundations after each operation. When the structure had been raised to the new and final profile, the columns were taken out and replaced with new ones.

Of course the swell in the line could not be effected without lengthening the track, and at first thought one would suppose that some sort of expansion joints would be required in the stringers and also in the track itself. But when we come to calculate how much longer the new track is than the old, we realize what a small difference an elevation of seven feet makes in a length of 1,400 feet. Actually the line on the present profile is only about an inch and one eighth longer than the old line. A variation of ten degrees in the temperature will produce about the same difference in length over a stretch such as this. Of course the elevated structure is provided with expansion joints, not only in the rails (with a maximum movement of three eighths of an inch at each joint), but in the main structure as

Raising the elevated structure together with its columns and column bases.



Lowering a double-deck bridge span into place by means of sand jacks.

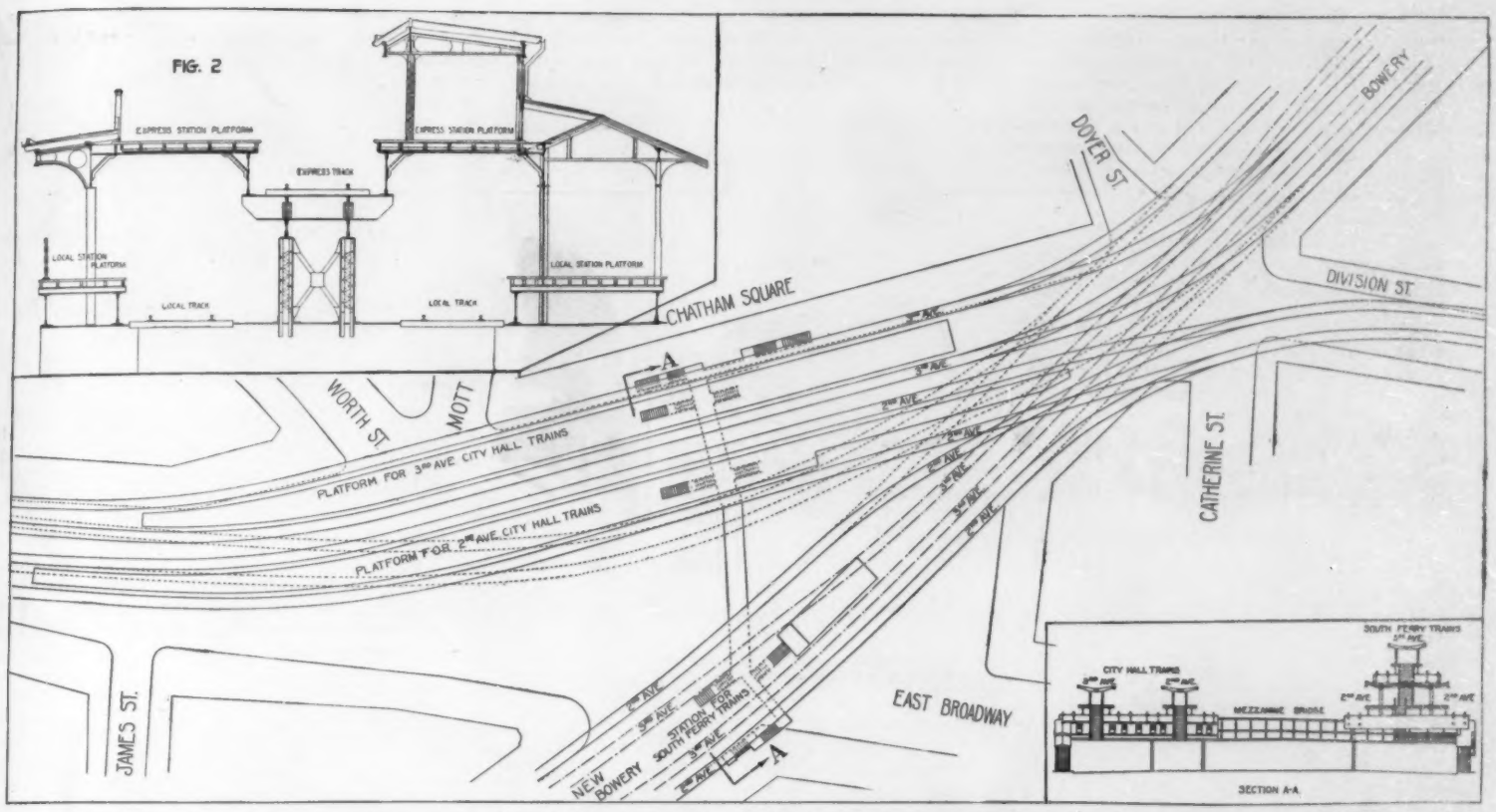


Fig. 1.—Map of Chatham Square, with a cross-section (AA) through the quadruple station. Dot and dash lines represent upper level tracks; dotted lines indicate old alignment. Fig. 2.—An overgrade station, showing how access is had to the express tracks.

well, and so the matter of increased length did not concern the engineers.

Moving the Structure Thirteen Feet.

Another interesting operation of somewhat the same order was carried on beyond the Harlem River, between 133rd Street and 143rd Street. Here the tracks of the Third Avenue elevated line are built on a private right of way. The two existing tracks were not centered on this right of way, but were built nearer the easterly side. In order to provide for a central express track, the southbound exisfing track had to be moved to the west a distance of 13 feet. This lateral displacement was accomplished somewhat after the manner of the vertical displacement just referred to. The length of the section moved is 2,800 feet, and at each end of this stretch the line curves westward, so that in moving the tracks to the west, the line was actually shortened about a foot. New piers were built along the new line of the track and the space between the new and the old pier was closed with blocking. Strips of steel were laid under the stringers. Then cables were passed around the new piers and attached to the stringers of the structure and by means of hand-operated turnbuckles or steamboat ratchets, the stringers with the tracks they carried were moved laterally a few inches at a time over a stretch of several hundred feet.

To complicate matters there are three stations in this 2,800-foot stretch. Of course it would not do to move the tracks away from the station platform. Accordingly a number of new floor beams were laid between the old floor beams and attached to the track structure. Then as the track was moved, these floor beams were drawn out. As soon as they had been moved out about three inches, the space was floored over by nailing narrow planking on them. Then the work proceeded until the tracks had moved out about three inches more, when the gap in the platform was closed by another strip of planking, and thus the work continued without ever having more than a gap of three inches in the platform. Because this section of the line is built on a private right of way, brick piers were used in place of the customary steel columns to support the structure and the new supports are concrete piers. At street crossings, however, steel columns have to be used and the method of procedure in this case was to move the entire structure with its columns. Timbered towers were built about the columns and supported on girders laid on the street surface. These towers supported the weight of the structure and then the foundations were removed from under the columns and the cross girders were disconnected. The top flanges of the girders were greased, and then by means of cables and steamboat ratchets the towers with the structure they supported were pulled bodily over to the new position. This work is shown in one of our photographs.

In order to provide for the shortening of the track, slip joints, arranged after the manner of a railway switch, were used; that is, the opposite rails were offset and switch points were arranged to slide on them, so that there was no appreciable change in the gage of the track. These slip joints were located at each end of the stretch that was moved, and here the track girders or stringers were moved out of alignment, so that one could slide past the other to make up for the shortening of the track as it was moved to the new position.

A Quadruple Station at Chatham Square.

The work that is now proceeding at Chatham Square and from there to the Brooklyn Bridge is exceedingly interesting. Provision is being made for running Second Avenue trains to the Brooklyn Bridge along Park Row. As this street is occupied by the Third Avenue line, and there is no room for four tracks, a double-deck elevated structure is being built here. The two upper tracks will accommodate the Second Avenue trains, while the lower tracks will be occupied by the Third Avenue trains. At Chatham Square, where the Second Avenue and Third Avenue lines come together, there will also be provision for running Second Avenue trains down New Bowery to South Ferry, and also for running Third Avenue trains over the same line. In order to avoid grade crossings, an elaborate track system is being put in, which is shown in Fig. 1. On the Bowery below Canal Street a five-track structure is being built; the outer, or existing tracks, will accommodate local trains. The center track will carry expresses north or southbound, while the tracks intermediate between the express and local tracks will carry trains to and from South Ferry. These tracks will run to an upper level so as to cross over the network of tracks at Chatham Square. Access to them will be had in a double-deck station at Chatham Square, the lower platform of which will give access to Second Avenue South Ferry trains. After passing the station, the Third Avenue tracks run down to the same grade as the

(Concluded on page 148.)

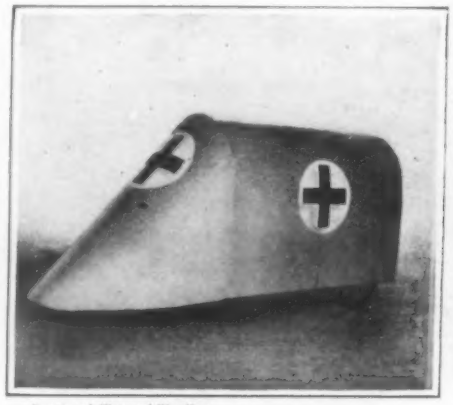
Grade crossings at Chatham Square, which are to be avoided by building upper-level tracks for Third Avenue South Ferry trains.

Looking south from the Chatham Square station for City Hall trains, showing Second Avenue tracks rising to upper level.

A Bullet-proof Stretcher

FIGHTING conditions have become so strenuous in the war zone that there is no certainty when or where hospital attendants, or red cross men, will be given immunity from attack when performing their duties of rescuing the wounded, and this is especially the case when working between the lines of opposing trenches, for the ever-present "sniper" is always on the lookout for a victim.

To meet these conditions a bullet-proof stretcher cover has been invented in England that appears to meet the conditions perfectly. This, it will be seen from the illustrations, consists of a long metal shield, arched at the top, and high enough to enable the attendants to stand upright within. At the front end the shield is rounded and sloped backward to deflect bullets, and two "eyes" are provided through which the attendants can see to direct their course, and locate the wounded. The whole contrivance is mounted on four wheels, and is provided with arrangements for supporting a stretcher. With this contrivance two hospital attendants can make their way in safety over a field exposed to rifle fire, and, after rolling the shield over a wounded soldier, he is placed on the stretcher, when a retreat is made to a place of safety.



Courtesy of *Illustrated War News*

A bullet-proof stretcher.

Interior view of the stretcher.

What the Railroads Are Doing to Reduce Death and Injury

By Thomas F. Logan

APPROXIMATELY one billion dollars was spent by the railroads of the United States last year to increase safety. The figures given are merely an estimate, but while they seem large the probability is that they barely cover the cost of abolishing grade crossings, the experimental tests on steel rails, the installation of improved signal and switching devices and the educational campaigns designed to inculcate the idea of "safety-first" into the mind of the public and railway employees.

Most fatalities on the railroads occur among the trespassers, who have no right to be on the railroad tracks, and among the employees who have a right to be there, but fail to regard the rules of safety. Nevertheless, as a result of the "safety-first" campaign, on the New York Central Railroad during the year which ended June 30th, 1914, as compared with the year ended June 30th, 1913, there were 102 fewer persons killed, a decrease of 19 per cent, and 1,068 fewer persons injured, a decrease of 12 per cent. During this period not a single passenger was killed.

The rules which provide that no employee is expected to take a chance, or run the risk of injuring himself or another, to save time or for any other reason have been generally adopted by railroads.

As part of the educational campaign a magazine is issued monthly, and a moving picture play is shown at various points over the entire line. The play is in the form of a human interest story with a safety moral, and depicts various unsafe practices in railroad work and the unfavorable results of forming unsafe habits. Some one of the leading railroads probably soon will group all its efficiency and safety work under one distinct department, which will work in close harmony with legislative bodies and public officials, and the public relations feature of railroad management will then be easy of solution. At the present time the railroads are not receiving credit for the work that they are doing, but must make progress in opposition to unintelligent legislative and governmental obstacles.

In addition to a safety bureau, a general safety committee, division and shop safety committees have been organized which report all unsafe conditions and practices they observe. Safety rallies are held along the lines of the road, at which stereopticon lectures are given, while a safety exhibit car is sent over all branches of the road. In addition to this educational campaign, hospitals, hospital cars and emergency cars to alleviate injuries and save life have been installed.

Several years ago, after various railroad wrecks, the experts of the Interstate Commerce Commission reported flaws in steel rails, but the attention given by consulting engineers to the strength of tracks, in order to accommodate the constantly increasing loads caused by increased size of equipment, has greatly decreased this form of accident. In fact, progress has been made in advance of requirements.

Many men have been seriously injured by the bursting of water glasses, and a special effort has been made during the last two or three years to develop a satisfactory shield. One of the road's mechanical men suggested an opening in the back of the shield connected with a pipe leading down under the cab floor, relieving pressure on the shield glasses and conducting the water, steam, broken glass, etc., through the pipe. Over 50 per cent of the accidents reported to the Interstate Commerce Commission on account of accidents to locomotive boilers or attachments cover scalding of men through use of squirt hose, and its place is now taken by a cold water squirt apparatus, and a number of engines have been equipped with it. If the experiment is satisfactory, it is probable that cold water squirt will be made a standard.

These are but a few of the devices which have been adopted in conjunction with the "safety-first" movement which focuses attention upon the immense possibilities of this field for the scientist and the inventor.

The "safety-first" idea has been a boon to inventors. More than that, it has provided a definite field for them in the railroad world in the future. The photographs which accompany this article show several phases of the "safety-first" work that has been done and is still in progress.

The policy of the railroads is to watch for all new inventions which might increase, even by a fraction, the safety to workmen, passengers and even trespassers.

The public has had little realization of what the "safety-first" movement really means or costs; how all the forces of science are being collected under that standard; and how limitless are the opportunities leading to the perfection of the ideal.

Showing railroad men motion pictures illustrating unsafe practices.

A safety exhibition for railroad men. Models and pictures showing safety devices and the proper way to perform their duties.

The Remarkable Snowfall of the Sierra Nevada

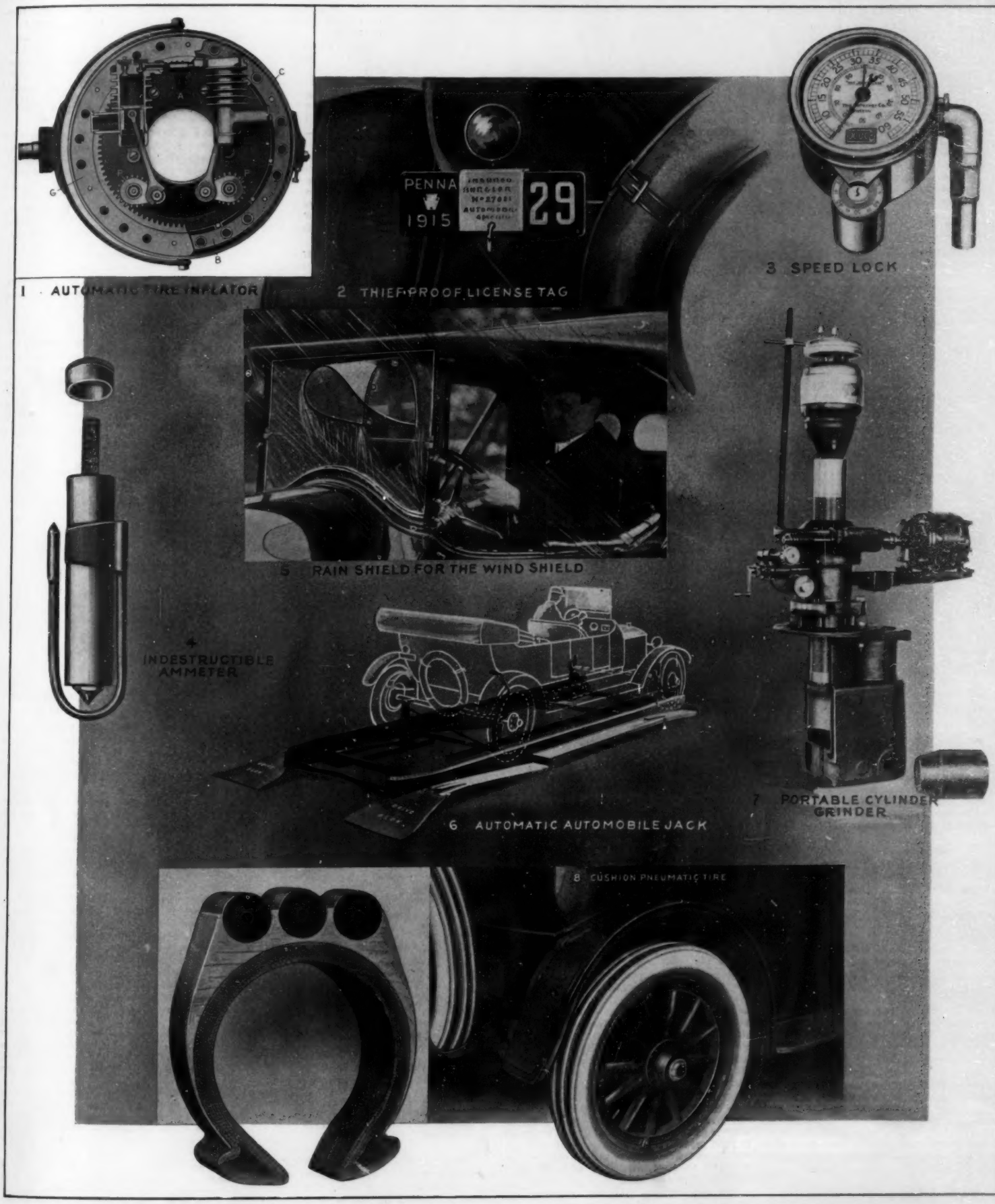
THE heaviest snowfall in the United States, so far as known, occurs in the high Sierra Nevada of California, especially in the region adjacent to the line of the Southern Pacific Railway connecting Sacramento, Cal., with Reno, Nev. According to a recent account of this region, published by Mr. Andrew H. Palmer in the *Monthly Weather Review*, it includes many square miles over which the average snowfall of the winter exceeds 100 inches. Moreover, at several points where measurements of snow have been made regularly by the Weather Bureau for a number of years, the average reaches much greater figures. Thus at Summit (Placer County, altitude 7,017 feet) it is 419.6 inches, while at Tamarack (Alpine County, altitude 8,000 feet) about 521 inches (43½ feet) of snow falls in an average winter. The "record" for a single season appears to be held by Summit, where no less than 783 inches, or 65¼ feet, fell in the winter of 1879-80. (These figures, of course, refer to the actual depth of snow as such, not the "water equivalent," as ordinarily entered in precipitation records.) The snow of the high Sierras furnishes most of the water used for irrigation in California, and is sometimes referred to as "The life blood of the State."

The remarkable measurements of snowfall above noted were not made in canyons or gulches, into which the snow had been drifted by the wind, but on open, level ground. In some cases, moreover, they have been verified by comparison with measurements at a large number of widely separated surrounding points, all of which gave figures of the same order of magnitude. The winds are light in this region, and there is not much tendency to drift.

The pressure resulting from the enormous accumulations of snow in the high Sierras produces astonishing effects. Mr. Palmer records that a fence at the Blue Canyon railway station had for its horizontal bars some discarded locomotive boiler flues of steel, 2 inches in diameter and 8 feet long. The heavy snow bent these to such an extent that they fell to the ground from their sockets in the wooden uprights. The Southern Pacific has built 32 miles of snowsheds between Blue Canyon and Truckee, at a cost of $42,000 a mile over single track and $65,000 a mile over double track. In an average year $150,000 is spent on these sheds in upkeep and renewals. They are built of massive timbers, and can support a layer of snow 16 feet in depth; whenever this amount is exceeded the snow must be shoveled off by hand. Flat-roof houses are unknown in this region. All roofs are gabled at a sharp angle to shed the snow. It is a common occurrence for one-story houses to be buried to the eaves or above.

Before the building of the railway the snow of these mountains made them nearly or quite impassable during about six months in the year. Attempts to cross them under such conditions led to many disasters; notably in the case of the "Donner party," of 83 persons, of whom 42 perished during the winter of 1846-47.

Motor Frame for Canoes.—For conveniently applying a motor frame to canoes Donald McLaren of Fort William, Ontario, Canada, has obtained a patent, No. 1,141,196, which provides a frame for connection with the end of the canoe and has means so it can be raised and lowered to lift the motor out of or set it into the water, floats being provided to buoy the motor and the propeller and prevent them from depressing the end of the canoe to too great an extent.



Some Novel Automobile Accessories

1. Automatic Tire Inflator, which is attached to an automobile wheel and keeps a punctured tire inflated indefinitely. *A* is a frame carrying the pumps and revolving with the road wheel; *B* is a frame carrying the toothed ring *G*, and held stationary by means of the band brake *C* carried by a stirrup at the end of a lever attached to some fixed part of the car; *PP* are pinions meshing with *G* that impart reciprocating motion to the pistons of the pump.

2. Thief-proof License Tag. A plate is fitted over the tag and secured with a padlock. Any unauthorized person who tries to run away with the car will be hailed by the first policeman he meets and recognized as a thief. Thus it makes an effective safeguard, whether the car be left on the sidewalk or in the garage.

3. Speed Lock. It consists of a speedometer which may be set for any limit of speed desired. A barrel-shaped lock with movable disk has figures to correspond with those on the speed-recording dial of the speedometer. This gage is set and locked at whatever speed is desired as a maximum, and the speed indicator, reaching that limit, closes a circuit in a magnetic release on the accelerator rod, slowly closing the carbureter, and reducing the speed of the car.

4. Indistructible Ammeter. A rugged instrument that is not affected by jars or knocks. It can be carried in the vest pocket or be thrown into the tool box. When testing a battery a little tongue projects from the barrel and shows the amperage up to thirty amperes.

5. Rain Shield for the Wind Shield. When driving in a rain storm the rain pouring down the glass of the wind shield obscures the view. A transparent bonnet attached to the glass by means of vacuum cups keeps a part of the glass dry, affording a good view.

6. Automatic Automobile Jack. It does not lift the car and does not depend upon momentum. The car follows the guide and when it reaches the proper place all four traps are instantly dropped from beneath the wheels, without any assistance from the driver. The car is left supported on rubber cushioned jacks with all wheels free to be turned for the adjustment of bearings, brake bands, removal or replacement of tires, tire chains, inspection, etc. By pressing a foot-trip the car may be backed off, when it automatically rights the jacks and resets the traps.

7. Portable Cylinder Grinder. A small motor-driven machine, in which the feed is entirely automatic. A one sixth horse-power vertical motor turns the cutting wheel and a one tenth horse-power horizontal motor feeds it downward.

8. Cushion Pneumatic Tire. Cushion tubes are imbedded in the tread of a pneumatic tire, providing a ribbed or grooved tread that serves to prevent skidding. The cushion tubes provide such a great thickness at the tread as to render the tire practically puncture-proof, and at the same time resilient and flexible.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

ARCH SUPPORTING SHANK FOR SHOES.—F. L. MASON and H. G. BENDIX, care of H. Bendix, 603 Macon St., Brooklyn, N. Y., N. Y. The invention relates to shoes and particularly to ladies' turn shoes or those wherein a special arch stiffener or support is necessary or desirable. It devises a special form of arch support for use especially in connection with ladies' turn shoes, and having special advantages in preventing distortion or twisting of the shoe shank.

WASHABLE CORSET.—MISS YOLE SAYNISCH, 325 3rd Ave., New York, N. Y. The invention has reference to washable corsets and the purpose of the improvement is to provide an inexpensive, convenient and sanitary corset which is provided with removable corset steels whereby the corset fabric can be as easily washed as any other washable garment.

PAJAMAS.—S. ELBAUM, 146 Dunbar Ave., Long Branch, N. J. This invention relates to wearing apparel, and its object is to provide a new and improved pajamas arranged to permit convenient vertical adjustment of the trou-

PAJAMAS.

sers relatively to the coat, to insure a proper fit of the trousers as to the length, and to enable the dealer to keep fewer sizes on hand, as the trousers can be fitted to persons of different height and girth.

Of Interest to Farmers.

APPARATUS FOR PREPARING MILK OR CREAM FOR TESTING.—H. EBB, Box 87, Paso Robles, Cal. It is important in this instance that the cream or milk be gradually and cautiously mixed with the acid, and it is a prime object of the invention to provide for mechanically imparting the necessary motion to the test bottle or tube to effect the mixing in a thorough and proper manner.

DISK PULVERIZER.—C. S. CAMERON, R. F. D. No. 2, Correctionville, Iowa. This invention provides an attachment for counteracting the side thrust of the soil on the disk gangs when in their working position, thereby relieving friction, and wherein the attachment is also designed to aid in returning the gangs to alined or inoperative position.

THRESHER TOOTH.—C. QUESNELL, 714 Spalding Bld'g., Portland, Ore. The invention is an improvement in the class of teeth which are used in the cylinder-and-concave thresher. The tooth has a curved base and a radial longitudinal rib and also transverse ribs formed integrally with the longitudinal rib and tapered from the base outward for the purpose of securing greater or less clearance.

Of General Interest.

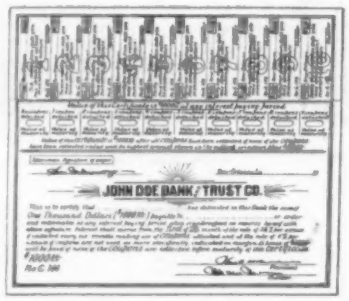
SMOKING PIPE.—S. E. P. MATACOTTA, 1347 E. 35th St., Brooklyn, N. Y., N. Y. The invention relates particularly to a device for filtering the smoke as it passes from the bowl to the mouth. Another object is to provide an improved filtering device arranged on the order of a cartridge so that the same may be inserted and removed at any time.

CAPSULE FILLER.—W. J. KIRKLAND, Box 17, Blackwood, N. J. The purpose of the invention is to enable a powder or analogous material to be effectively measured and charged into capsule bodies, after which the bodies are provided with caps, the several operations being performed with a minimum expenditure of time and labor.

SUPPORTING REEL FOR WOUND COILS.—F. CRAWFORD, care of C. Ehlermann, Jr., 165 Broadway, N. Y., N. Y. This invention avoids any retardation or drag on a coil when unwinding the same; provides an expansible core while being unwound; provides means for securing a coil in the reel; provides a structure, the operation whereof serves automatically to exert a braking influence on the rotating structure when paying out the strand of which the coil is constructed.

STICK PIN GUARD.—M. WEINTRAUB and A. KATZ, care of the former, 115 Washington St., Hoboken, N. J. This invention relates to jewelry and has particular reference to scarf pins, stick pins, or the like. It provides an improved safety attachment, or lock for cooperation with the shank or pin portion of the stick pin so as to prevent loss or theft thereof.

COUPON CERTIFICATE OF DEPOSIT.—M. S. SENTON, New Orleans, La. The invention refers to instruments of obligation such as are issued by banks or other parties to depositors. It provides a coupon certificate of deposit, pro-



COUPON CERTIFICATE OF DEPOSIT.

viding for two rates of interest, and arranged to show at all times the interest to which the depositor is entitled, thus rendering the coupon certificate advantageous and attractive to the public and to the bank issuing the same.

LEVELING ROD.—W. F. WHITTIER, Delaware, Ohio. The invention provides a leveling rod by which an elevation can be read directly on the same without computation. The invention attains its object by means of a rod resembling in construction rods now used in the art except that the linear scale is movable and numbered successively in increasing order downward from any point on the scale.

BOTTLE.—R. D. MUNO, Calzada, 131 Vedado, Habana, Cuba. The invention relates to bottles, jars and the like, having particular reference to sealing or closure means for such containers. It provides a bottle with a neck into which is fitted a stopper and providing a locking means for said stopper which cannot be released without breaking a portion of the bottle neck.

STANDING WEATHERPROOF SEAM FOR ROOFING FELT.—H. VON UFFEL, care of Prince George Hotel, 28th St. and 5th Ave., New York, N. Y. An object of this invention is to provide for the expansion and contraction of the roofing strips and prevent buckling or wrinkling and at the same time secure weatherproofness at the seam without the need of cement as is commonly necessary and render the roofing more attractive in appearance.

HAIR WAVING DEVICE.—DAISY B. THOMAS, Lessing Apt's., 4 D. Surf and Broadway, Chicago, Ill. The purpose here is to provide a device arranged for convenient attachment to the hair of the user to wave the same in a lasting and natural manner and in a comparatively short time and without the use of heat or inflicting injury or producing discomfort to the user.

INSECT POWDER CONTAINER AND SPRINKLER.—S. H. LOUIS, 1068 Franklin Ave., Bronx, N. Y., N. Y. This device embodies top and bottom sections connected to a flexible lateral section or body and normally held distended by an interior spring seated within said top and bottom sections, while the top is provided with a spout or other outlet through which the material or powder is discharged.

BAIL.—C. F. PERRY, Box 91, Bangor, Maine. This invention provides a bail which can be maintained in predetermined fixed positions relative to the utensil. The bail can be placed in fixed predetermined positions relative to the utensil and whereby the utensil can be conveniently handled, particularly when the same is used for hot contents.

FOLDING HAND BAG.—S. J. PROKESCH, 809 Canal St., New York, N. Y. The invention relates to hand bags of that type having a flexible bag which can be folded into a plurality of folds whereby the depth or the capacity of the bag can be changed at will. It is so designed that the fastening and unfastening of the folds can be easily and quickly effected.

PITMAN BOXING.—J. CHURCHILL. Address 1211 California Ave., Bakersfield, Cal. This invention is an improvement in boxings used on pitmen for well boring, and the object is to provide a reliable bearing which will automatically take up the wear between the wrist pin and the bearing blocks, and will make a quickly demountable, accurate bearing.

Hardware and Tools.

WRENCH LOCK.—F. E. SMITH and G. W. SMITH, care of the latter, 28 Knapp Ave., Middletown, N. Y. This invention provides a device or mechanism for preventing the undesirable movement of the movable jaw when it is necessary or required for such jaw to be retained in any predetermined position to which it may be adjusted, as, for instance, for repeated operation upon the same nut or upon a number of nuts of the same size.

TENSION DEVICE FOR SCISSORS AND SHEARS.—G. H. BEACH, Litchfield, Minn. The invention provides a device arranged to maintain a uniform tension on the blades to insure proper cutting, to allow of conveniently taking the blades apart for grinding or other purposes, and to prevent undue wear of the parts.

CLAMP FOR HOISTING ROPES.—J. J. K. KOUGHAN, care of G. J. Waller, 509 Insurance Bld'g., 311 California St., San Francisco, Cal. This hook is for use for handling freight, the device being particularly serviceable on ship board and in warehouses. The device comprises a slotted link and a hook pivoted therein, both the link and hook being provided with extensions adapted to clamp the rope when properly adjusted therewith.

DIAMOND CUTTER'S DOP.—I. LANG, 183 E. 3rd St., New York, N. Y. This invention overcomes the disadvantages in the dops now commonly employed. It provides an efficient means for firmly clamping the stone in the dop in such a manner that the table and two facets can be ground without requiring the stone to be unclamped and repositioned.

WIRE PLIERS ATTACHMENT.—C. J. JOHNSON, Correctionville, Iowa. The invention provides a wire cleaner which can be easily and quickly attached to any wire pliers and whereby wires to be spliced can be easily and quickly cleaned by the attachment carried by the pliers without the aid of any auxiliary tool, as is customary.

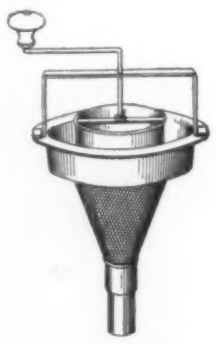
Heating and Lighting.

GAS HEATER.—H. E. LOEBE, 1700 Boulevard, Jersey City, N. J. The purpose here is to provide a heater more especially designed for economically heating rooms with a minimum consumption of gas, and to allow of using the gas heater for heating water, or for cooking purposes, or for use in ranges, hot air furnaces and the like.

GAS GENERATING SYSTEM.—C. E. CLARK, 40 W. 4th St., New York, N. Y. In the present patent the invention has reference to improvements in gas generating systems, and has for an object to provide an improved structure which may use crude oil or any desired oil, and produce a gas easily transported and ready for use at all times.

Household Utilities.

SAUCE STRAINER.—LILLIAN B. HETTEL, 386 Campbell St., Rochester, N. Y. The invention relates more particularly to strainers of a type suitable for preparing and refining various kinds of sauces and analogous materials, such, for instance, as catsup. The strainer subjects the pulpy substances therein con-



SAUCE STRAINER.

tained to the uniform action of a sieve through which the pulpy materials pass. It enables certain kinds of foreign substances contained with the sauce or other material being operated upon, to be held back from the material passing through, and ultimately removed from the strainer.

Machines and Mechanical Devices.

CHANGE SPEED GEARING.—V. H. MCDOUGAL, North Robinson, Ohio. The invention relates to transmission devices for traction vehicles or other machinery, and has particular reference to change speed mechanism. It provides a plurality of possible speeds from a driving element having constant uniform speed, and each speed being through a direct drive.

BELL RINGING DEVICE.—E. REBISCHUNG, 79 Wyona St., Brooklyn, N. Y., N. Y. The invention has for an object the provision of an improved construction which is designed to swing a bell regardless of the weight of the bell, the same being swung in the usual manner for causing the ringing thereof in such a way as to produce the best results.

MACHINE FOR PREPARING THE CONDUCTING WIRES OF ELECTRIC IGNITERS.—J. KRANNICHFELDT, Cologne-Niehl-on-the-Rhine, Germany. The characteristic feature of the invention consists in winding the wires, which are taken from suitable rolls, several times (for example four times) around at least two stationary pins arranged at a distance apart, by means of a suitable winding arm. Around the skein thus formed one end of the two wires can then be spirally wound, and the opposite ends, to which the electric fuse is to be attached, may be twisted together.

AUTOMATIC ANNUNCIATOR.—J. H. GENTER, 13 Golden St., Newburgh, N. Y. The purpose here is to provide an annunciator arranged to display the time of the day or night on a distant surface, together with any desired legend or other subject matter, such as advertisements, titles of vaudeville acts, or of moving pictures, etc.

SUCKER ROD PULLER.—J. B. DUNLAP and W. D. BRYAN. Address the former, 618 N. Boston Ave., Tulsa, Okla. This improvement provides a device for pulling a sucker rod from a well casing, wherein a plurality of gripping mechanisms is provided, one of which may be attached to the well casing and the other to the pumping jack, and wherein the said devices are arranged to grip the sucker rod alternately.

WIRE CLOTH RACK.—W. G. NEWMAN, care of Stievell-Paterson Hardware Co., Salt Lake City, Utah. An object here is to provide a device in which wire cloth may be stored in rolls and when wanted may be easily unrolled, cut off and measured. A further object is to provide a holder which may be quickly adjusted to accommodate wire cloth of different widths.

NAVIGATOR'S COURSE MARKER AND FINDER.—E. Y. HASKELL, 31 Bellevue Place, New London, Conn. This invention relates to nautical instruments and has particular reference to devices used in connection with ships' binnacles to facilitate the direction or location of distant objects. The improvement simplifies the construction and operation of this character of instruments, whereby not only does the inventor lessen the cost of the same, but he is able to produce an instrument of the maximum simplicity of manipulation and control.

NAVIGATOR'S COURSE MARKER AND FINDER.

MASSAGE APPARATUS.—F. SHURTLEFF and W. SHURTLEFF, 2613 5th Ave., Moline, Ill. This invention relates to an improvement in a massage apparatus and more particularly to a pneumatic massage apparatus. It provides a massage apparatus in which rapid shifting of pneumatic pressure from zone to zone over the surface being treated is obtained.

CAMERA ATTACHMENT.—H. WHITAKER, 27 Kendrick St., Lawrence, Mass. This inventor provides an attachment adapted to be connected to a camera at either of its tripod sockets and embodying mechanism operated at a distance, by means of which the cable release may be actuated, so that the photographer may himself appear in the picture.

HYDROPNEUMATIC PUMP.—B. S. H. HARRIS, Greenville, S. C. This device is arranged within a source of supply and having two pump cylinders for containing the water from which the water is intended to be driven to the place of utilization by fluid pressure, and wherein check controlled inlet valves are provided for admitting the water to the cylinders, and wherein fluid controlled mechanism is provided, controlled by the height of water in the cylinders for cutting off each cylinder from the source of pressure when nearly exhausted, and for connecting the other cylinder to the said source.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

A Mechanical Eye

(Concluded from page 138.)

band of the lower right part of the letter. Likewise the upper crystal will be the last to cease action. It is thus seen that every letter of the alphabet, and in general any character whatsoever, will have its characteristic sound.

In the same figure the diagram of electrical connections shows how the responses of the crystals are made evident in telephone receivers. Each crystal forms an arm of a Wheatstone bridge. The telephone receiver for that crystal replaces the galvanometer of the Wheatstone bridge as ordinarily used. Three telephone receivers are drawn in the diagram, but if three or even more crystals need to be used, the solution in behalf of only two ears is seen from Fig. 2 of this diagram. According to this figure, with two telephone receivers four crystals are readily accommodated. However, the instrument appears to give very good results with only two crystals, one for the upper, the other for the lower part of the letter.

In series with each telephone receiver there is an interrupting device giving a definite frequency to the current, and a resonating arrangement in the receiver changes this frequency to one of definite musical pitch, a different pitch for each crystal. It is a change in the intensity of one of these pitches that marks the entrance into the band of illumination of a region of darkness, such as a portion of some letter.

The photograph, Fig. 3, shows the whole apparatus in its present stage of development. The total weight is only 35 pounds, while the mechanical eye, which is the upright closed box, shown in position for reading from a book, weighs but 2 pounds, and its weight can probably be reduced to a fraction of a pound.

The Mechanical Eye.

This box contains the crystals (which respond to the light in a manner similar to the action of the rods and cones of the human eye), the source of illumination producing the band of light on the page, and the necessary lenses, together with some minor parts. The lens and crystals as shown in Fig. 2 are mounted in the box, so that with the page lying horizontally upon a table the line joining them makes a certain angle with the vertical, as in Fig. 4. In this last figure S is a source of light, such as the filament of a Nernst glower or of a special incandescent lamp, L', the lens to focus the light on the letter at a on the page P, through an aperture in the bottom of the box E. L' the lens system to receive the reflected, or diffused, light and focus it, in the form of an image of the illuminated part of the page, upon the crystals at C. The mechanical eye is seen with the cover removed in the large photograph, Fig. 5.

Comparison of the Phonopticon With the Optophone of d'Albe.

Compared with the optophone of d'Albe the phonopticon is a decided advance. By the use of isolated crystals rather than masses of selenium of minute crystalline form, in selenium "cells," a sensitiveness a hundred times greater has been obtained. Because of this increased sensitiveness due to the crystals, the practicability of the instrument does not depend so much upon highly sensitive conditions in the telephone receivers. It is almost astounding that Brown used but two crystals at San Francisco, one for the upper, the other for the lower part of the letter, as compared with d'Albe's eight holes and as many musical frequencies. Two, or even four, musical frequencies are more easily attended to by the operator than eight. In d'Albe's device letters are to be distinguished by the omission of certain tones, while the phonopticon of Brown responds positively according to what is in the field; in other words, the entrance of a letter causes the tones to sound. Also, the audible tones of the phonopticon are very distinct, which was not true of the earlier instrument, and they can be made as loud as would be desirable. The phonopticon, furthermore, does not require a relay for the purpose of intensifying the sound as does the optophone. In the d'Albe instrument the book or newspaper is inverted over the apparatus, and must itself be moved past the aperture. The disadvantage of this with large and heavy books is apparent. No matter how heavy the book the mechanical eye of the phonopticon is moved with equal ease over the page. By means of a simple adjustment of the "eye" the phonopticon can be adapted to varying sizes of type, corresponding to a similar adjustment in the d'Albe instrument. The great difference between the phonopticon and its predecessor lies, of course, in the use of selenium crystals rather than cells.

How the Crystals Were Discovered.

It is not every piece of work of purely scientific character that proves to have an immediate and direct practical application. The case of the new selenium crystals first produced by Dr. Brown, however, is one of the notable exceptions. Pure science is his field and he has stepped aside temporarily only that the clearly seen possible benefit of the new crystals to the blind should be realized. The historic scientific background explaining the final production of the crystals is as follows:

To the research worker in physics the problem of the conduction of electricity through metals has been one of the most fascinating and baffling with which he has had to deal. The metal selenium has been one of the most promising for research along this line because of the property already mentioned of changing its electrical resistance in passing from one intensity of light to another. Work with selenium is doubly important for the possible information it may give concerning the known intimate relation between electricity and light. Scientific workers on selenium have hitherto been restricted to experimentation with selenium "cells"—at least these cells have offered the most fruitful field. The cells, as was stated, are composed of a mass of selenium of minute crystalline grain, crystallized *in situ* from an amorphous form, over a wire wound spirally about a small slab of soapstone or similar material. The electric current used for the study of the cell passes partly by way of the wire and partly through the selenium mass bridging over the spaces between successive turns of the wire. As the selenium bridges change their resistance with varying intensity of the incident light, the total current passing through the cell, of course, changes also. Now there have been several facts of uncertain interpretation regarding selenium, uncertain because of the necessarily complex conditions inherent in a selenium cell. It was apparent to Brown and his associates at Iowa University that if they could isolate crystals of metallic selenium of sufficient size to be worked with individually, a number of these disputed points might more easily be settled. Turning their attention to the production of selenium crystals, they were finally rewarded with crystals of the desirable size. Altogether about four years' labor have been necessary to produce desirable results. The method of crystal production is to inclose the uncrystallized selenium in a glass tube, raise the tube to a high vacuum, sealing it shut while in this condition, and then placing the tube with its contents in an electric oven, where it is kept at constant temperature for weeks and even months before the selenium crystals have grown to the desired size. Some of them required three months in the electric oven at a constant high temperature. The slow process of crystallization proceeds by the distillation of the amorphous selenium, and the crystals are found clinging to the upper walls of the tube. Photographs of the crystals, reproduced from the *Physical Review* and the *Philisophical Magazine*, are shown in Fig. 6.

With these large crystals there have already been settled several of the uncertain points regarding the action of light in selenium, while numerous questions that the crystals and not the cells can satisfactorily answer await further investigation. The progress of this scientific work is recorded in articles that have appeared during the past year, chiefly in the

Philosophical Magazine and the *Physical Review*. Some of the more interesting facts drawn from a study of the crystals are: that the seat of the light action in selenium is in the mass of the selenium itself and not at its contacts with the electric circuit; that the crystals all show change in electrical resistance with exposure to light; that the resistance depends on the mechanical pressure to which the crystal is subjected, as well as on the light intensity; and, perhaps most remarkable of all, that the crystals possess a new property, hitherto unobserved in matter, and that is their power of transmitting the light action along their whole length, apparently through some sympathetic response that takes place in the mechanism of the crystal structure. These are facts primarily of scientific interest. The practical application of the crystals in the phonopticon is only incidental, although most important from an altruistic viewpoint.

Further work with the crystals promises even greater size and sensitiveness. With the phonopticon at its highest perfection the blind will not only be reading books and magazines accessible to anyone else, but will probably also be appreciating photographs and paintings, and possibly even viewing the landscape.

Railroads Over and Under the Streets of New York

(*Concluded from page 143.*)

Second Avenue tracks and join them. To provide for the City Hall trains there will be another station at Chatham Square, consisting of two island platforms connected by a mezzanine, while a mezzanine bridge will run across to the station for the South Ferry trains. Immediately below Chatham Square station the Second Avenue City Hall tracks will climb to an upper level, so that they will run down Park Row, above the Third Avenue trains. Much of this work has already been done, and it will be realized that it is extremely difficult because it is being carried out without disturbing the traffic at this busy junction. The new Chatham Square station for City Hall trains has already been built, and this involved moving the old tracks to the westward. Our map, Fig. 1, shows, in dotted lines, the position of the old tracks, while the dot and dash lines indicate the upper level Third Avenue tracks.

A New Double-deck Bridge Over the Harlem River.

There is another point where the Second and Third Avenue lines come together in a double-deck structure, and this is at the crossing of the Harlem River. Here, in place of the old bridge, a new double-deck bridge is being built. The manner of constructing this bridge, while not new from an engineering point of view, is very interesting. The two double-deck shore spans have already been set in place, and in the course of a few weeks the center or draw span is to be located. The spans were erected on scaffolding near the site of the bridge. When everything was ready for a span to be moved into position, it was lifted off the false work by means of scows introduced at low tide and raised by the tide. The span was then floated into position, while the existing span was removed in a similar manner by floating it off on the tide. In order to avoid the delay of waiting for the tide to lower the span into place, sand jacks were used. These are shown in one of the illustrations. They consisted of boxes filled with sand, on which rested plungers that supported the bridge span. At a given signal valves were opened in the bottom of each box, letting the sand flow out and permitting the plunger with its load to sink, thus bringing the bridge span down into position on its bearings.

As explained in the first installment of this serial, the work on the new rapid transit system of New York is so extensive that we can only touch on a few of the more interesting features. Nothing but a personal inspection of the work that is being pursued so indomitably, under and over the busy streets and beneath the deep rivers, will give one an adequate con-

INQUIRY COLUMN

READ THIS COLUMN CAREFULLY. You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. *In every case it is necessary to give the number of the inquiry.* Where manufacturers do not respond promptly the inquiry *may* be repeated.

MUNN & CO., INC.

Inquiry No. 9431. Wanted to purchase a mold for shaping and piercing beads made of rose leaf of the consistency of dough.

Inquiry No. 9432. Wanted the name and address of a manufacturer of watch glasses 9 inches in diameter.

Inquiry No. 9433. Wanted the name and address of a manufacturer of a material such as is used by gas mantle makers. The material is used to cover the wire frame that supports the mantle at the top and is used to protect the wire from the flame or heat of the mantle.

Inquiry No. 9434. Wanted the name and address of a manufacturer of special pins, 1/16 of an inch in diameter and ⅜ of an inch long, the pins to be made of bone.

Inquiry No. 9435. Wanted the name and address of a manufacturer who can furnish grinding machines for the hollow grinding and finishing of razors. Up-to-date machines wanted.

Inquiry No. 9436. Wanted the name and address of a manufacturer of rat traps having a receptacle attached into which the rat drops and drowns.

Inquiry No. 9437. Wanted the name and address of a concern that can make an oil or grease gun. West preferred. Must be able to make in quantities of 10,000.

Inquiry No. 9438. Wanted the name and address of a manufacturer of light aluminium sheets, small tubing, rods and wire, also aluminium solder.

Inquiry No. 9439. Wanted the name and address of a manufacturer of a knitting machine which was on the market some years ago. The name of the machine was the Bickford Machine. It was a hand knitting machine, weighing about 15 pounds.

Inquiry No. 9440. Wanted the name and address of a concern selling Dr. Young's E-Z Sanitary Belt.

Inquiry No. 9442. Wanted the name and address of a manufacturer of a machine for cutting skeins of cotton and wrapping each bundle around the middle with wire. A machine of some such kind is used in the brush trade for wiring and cutting to length the bundles of bristles for paint brushes.

Inquiry No. 9443. Wanted the name and address of manufacturers of fuel oil burners and fire wall equipment, suitable for a maximum quantity of water evaporation in a locomotive firebox of the following dimensions: 2½' between door and flue sheet, 3' between grate level and crown sheet, 3' between side walls.

Inquiry No. 9444. Wanted the name and address of a manufacturer or patentee of a glass preserving jar made for use with air pumps for creating a vacuum.

Inquiry No. 9445. Wanted the name and address of a manufacturer who can make a combination pencil holder and point protector.

Inquiry No. 9446. Wanted the name and address of a manufacturer who can supply machinery for automatically wrapping cigars in thin imported tissue paper having the ends tightly wound and curled. Would consider purchase of machines or patent rights.

Inquiry No. 9447. Wanted to buy patented article, which is needed in every home, with a possible view to manufacturing and distributing.

Inquiry No. 9448. Wanted to get in touch with manufacturers who can make small gasoline motors and parts thereof. Must be able to handle considerable orders with expedition.

Inquiry No. 9449. Wanted the name and address of a manufacturer who is prepared to build a new and very simple stationary engine with or without gas producer.

Inquiry No. 9450. Wanted the name and address of a manufacturer who can build a light simple motor for light automobiles and for portable farm work.

Inquiry No. 9451. Wanted the name and address of a manufacturer of machinery for making egg albumen.

Why Early Cancer is Curable

THERE is still a widespread misapprehension that cancer is a constitutional disease caused by some substance or poison in the blood. Those who hold this mistaken opinion commonly believe that the disease is hereditary, and in a vague way they think there must be some taint handed down from one generation to another which causes cancer to flourish in certain families. In the minds of people not well informed on the subject this belief may well cause a feeling that it is somehow shameful to have the disease. Such misapprehension, combined with the notion which has long prevailed that cancer is a hopeless, incurable affliction, and that it is of no use to try to have anything done for it, may well account for the extraordinary delay of many sufferers in seeking treatment. A further cause is the fact that cancer, in the early stages, often causes little or no pain. Many a surgeon has wished that cancer, in its early manifestations, might cause the sufferer half as much trouble as a toothache, for then the patient would surely be driven to seek relief so quickly that he or she would be easily cured.

That cancer is at first a local growth and not a general disease of the system is now clearly established. This fact is of the utmost importance, since it holds out a high hope of cure if the malignant growth is removed before it has time to spread to other parts of the body. Cancer beginning in one spot later appears elsewhere, because small particles or cells are carried away from the first site and start other growths, not because there exists previously some poison in the blood which causes the disease to break out in different parts of the body. The great hope of cure, therefore, lies in removing cancer entirely from the system before it has a chance to spread from its first foothold.

The reason why so many people came to believe that cancer was a blood disease is doubtless because it was observed to come again in the same or other parts of the body after having been apparently cut out. It was natural to assume that when the disease kept coming back in this manner there must be some cause or taint in the blood which led to its breaking out in different places much like certain skin diseases. The trouble which started this fallacious reasoning was that in those earlier days cancer was not so well understood as it now is. Surgeons then did the best they knew how, but without the advantages of modern methods they were unable successfully to exterminate the disease. The microscope has now shown us the paths by which cancer cells start their invasion of the body if the first and local appearance is neglected. Modern surgeons are, therefore, repeatedly successful in removing the disease once for all. As an eminent American doctor has well said, "It is not surgery, but *delayed* surgery that fails to cure."

Power Wagons in War

THE use of power wagons of a multitude of types is one of the original features of the war. At the beginning of hostilities the various nations engaged in the war were said to dispose of some 250,000 power wagons, properly so-called, having a net load capacity of 2 to 4 tons. Army subsidized standard types, built by various constructors, figured in this list. France stood in the lead with 90,000 power cars, then came Germany with 70,000 cars, England with 55,000, Austro-Hungary with 25,000, while Russia counted 10,000. But it should be remarked that these figures refer only to what are properly known as power cars and do not include ordinary pleasure or touring automobiles, nor on the other hand special types of war makeups, as armored power wagons with machine guns or cannon and the like, nor the class of motorcycles. It is stated in a Paris publication that on the second day of mobilization last year, as many as 500 autobuses went to the frontier, each carrying 40 soldiers, and on the next day 1,000 others took the same direction.

Will England Still Be Mistress of the Seas When Peace is Declared?

DESTRUCTION OF THE INVINCIBLE ARMADA

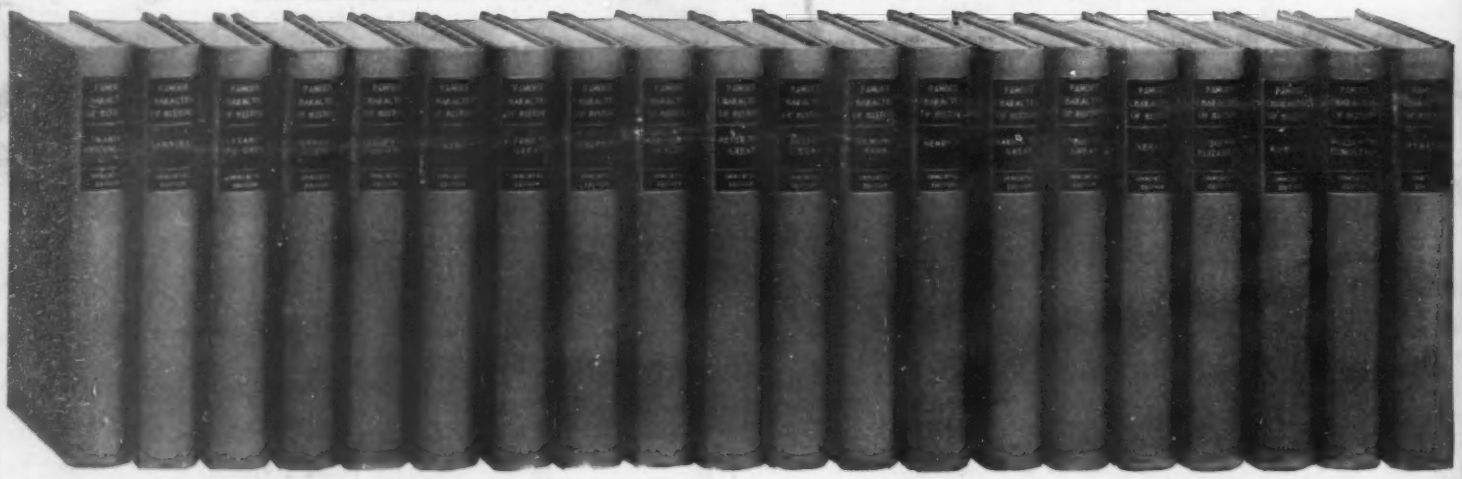
THERE were anxious hearts in England that August morning over three centuries ago. The long expected Invincible Armada had been sighted in the English Channel, covering the seas as far as the eye could reach. But Elizabeth was prepared! With smashing blows her gallant admirals—Drake, Raleigh, Hawkins—drove their stout little ships against the huge galleons of Philip of Spain and put them to utter rout. Elizabeth made England Mistress of the Seas.

But it was Alfred the Great who laid the foundation of England's naval power. We see him through the mist of ten centuries hurling back the invaders of his country by land and sea—Had Saxon Harold's fleet not been caught unprepared, the invasion of England by William the Conqueror might not have been accomplished with such terrible success. All this is thrillingly told as never before in the volumes on Queen Elizabeth, Alfred the Great and William the Conqueror in that work unique among the world's writings, grand in its conception, marvelous in its execution—

IT was Emerson who said: "There is properly no History, only Biography." Every step forward or backward in the march of civilization has been directed by some overwhelming mind, some individual who loomed far above his fellow men and whose example, as guide or warning, is the most precious part of our heritage from the ages. In these twenty superb volumes we have the world's biography covering 2500 years of history written around the lives of those dominant human forces—the men and women who made the history of their own day.

Instead of a history of the ancient world, we have Cyrus and Xerxes and Darius and Hannibal with the ancient world around them. We have Caesar in the Senate, or surrounded by his legions, extending the boundaries of Rome to include all the known parts of the earth, as he gives to his ambitions the wings of fancy and the feet of accomplished fact. And we see the tide of Rome's destiny, and, therefore, that of the world, turned aside because of the beauty of a woman—Cleopatra.

FAMOUS CHARACTERS OF HISTORY



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3. Cyrus the Great
4. Hannibal
5. Pyrrhus
6. Peter the Great
7. Genghis Khan
8. Hernando Cortez
9. Marie Antoinette
10. Romulus
11. Mary Queen of Scots
12. Henry IV.
13. Xerxes
14. Julius Caesar
15. Nero
16. Cleopatra
17. Darius the Great
18. Josephine
19. Queen Elizabeth
20. Alfred the Great